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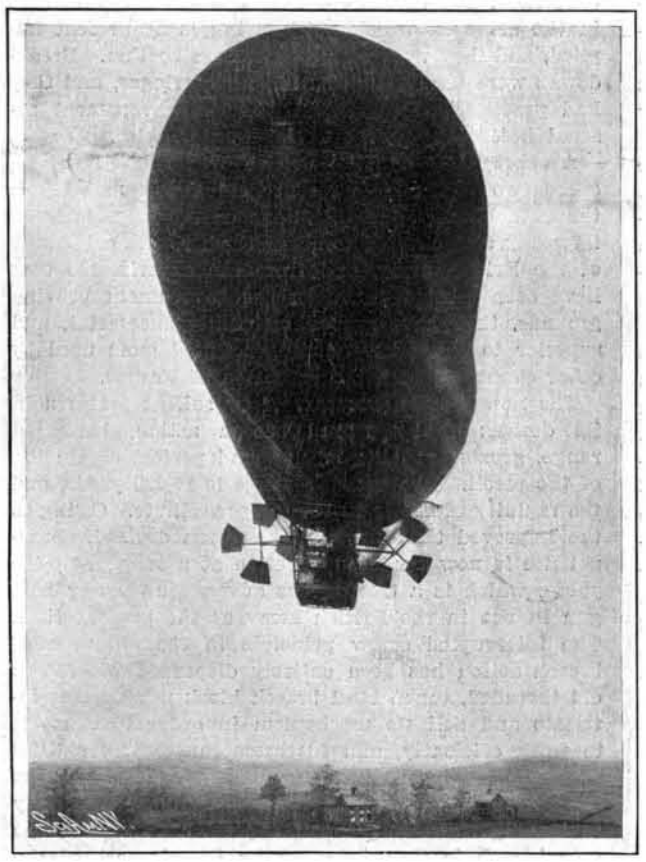

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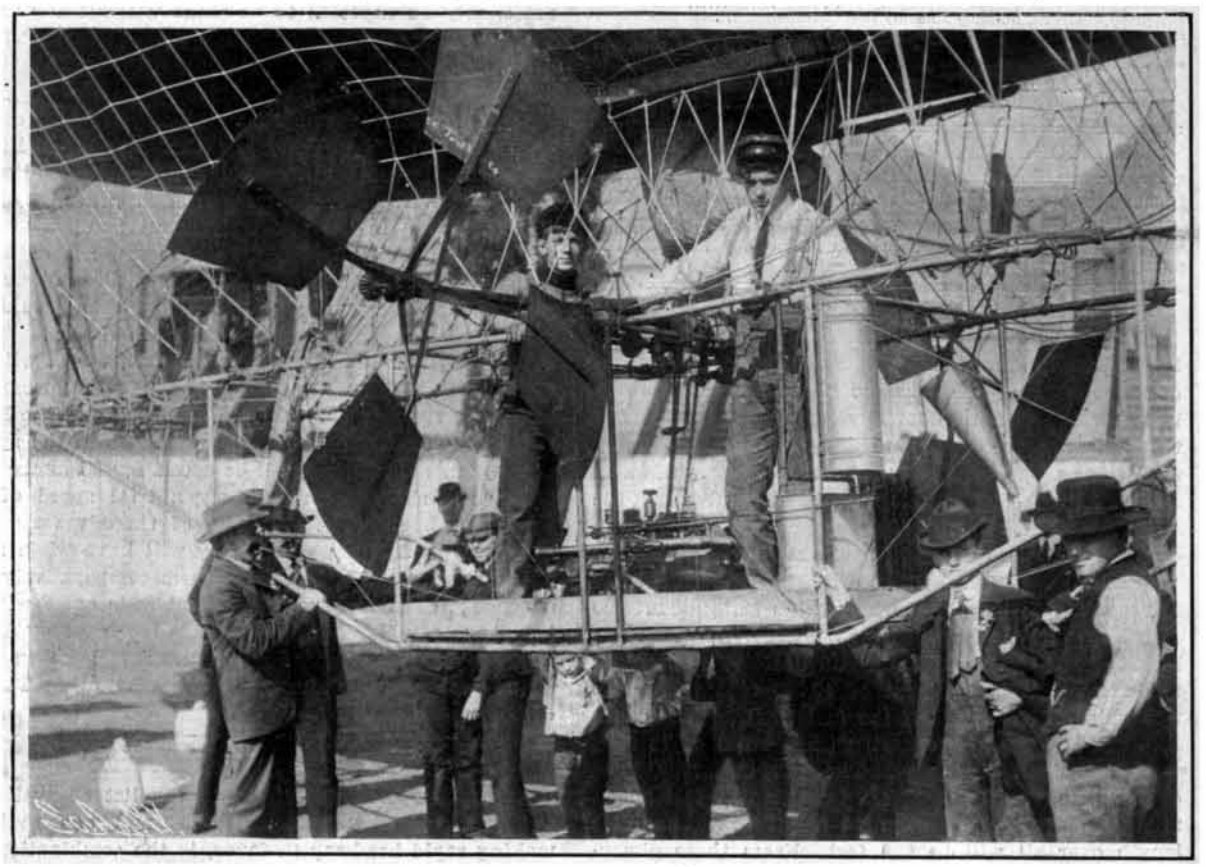

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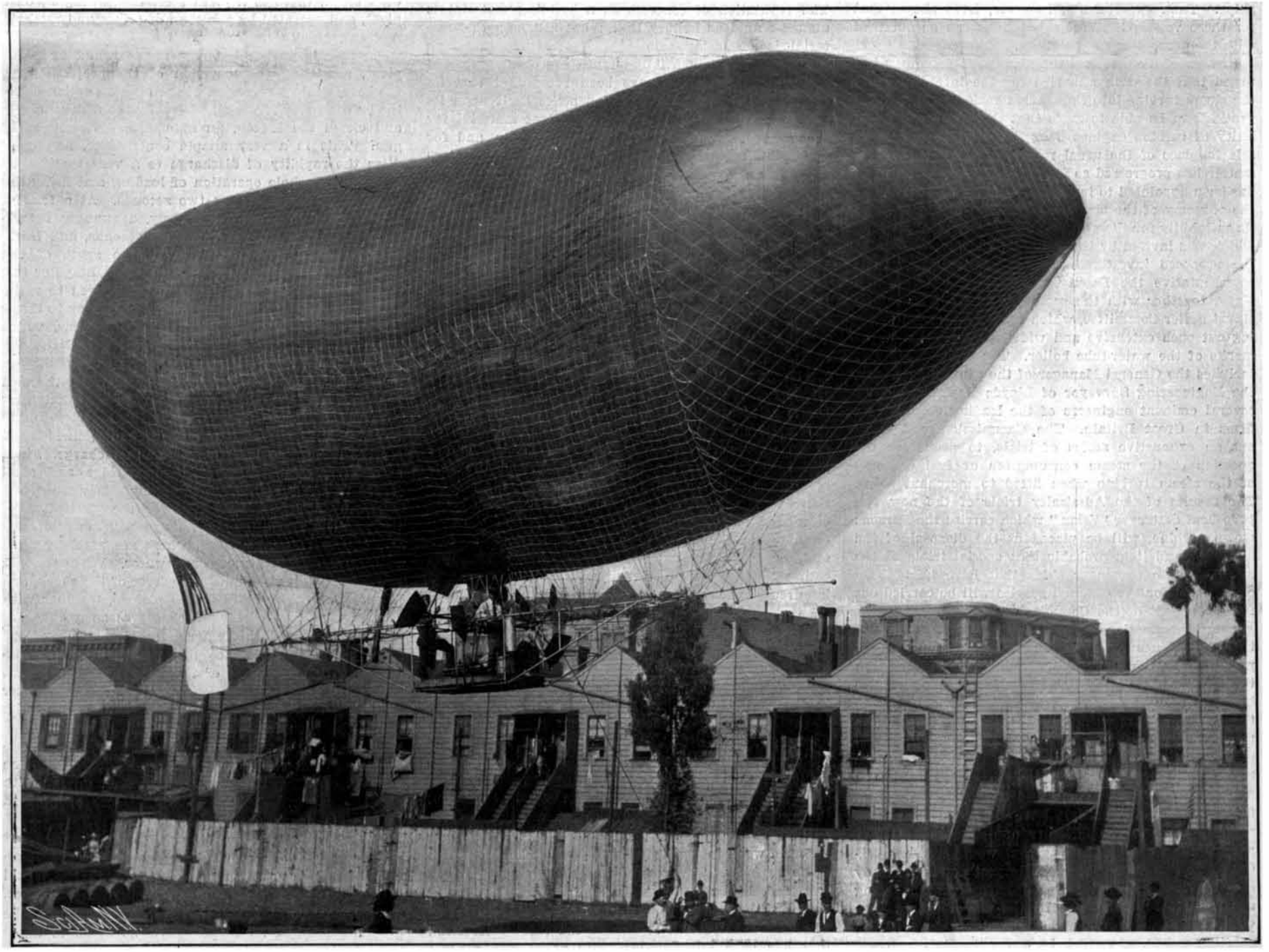

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DR. AUGUST GRETH'S AIRSHIP BEFORE ITS START ON OCTOBER 18 FROM SAN FRANCISCO.—[See page 327.]

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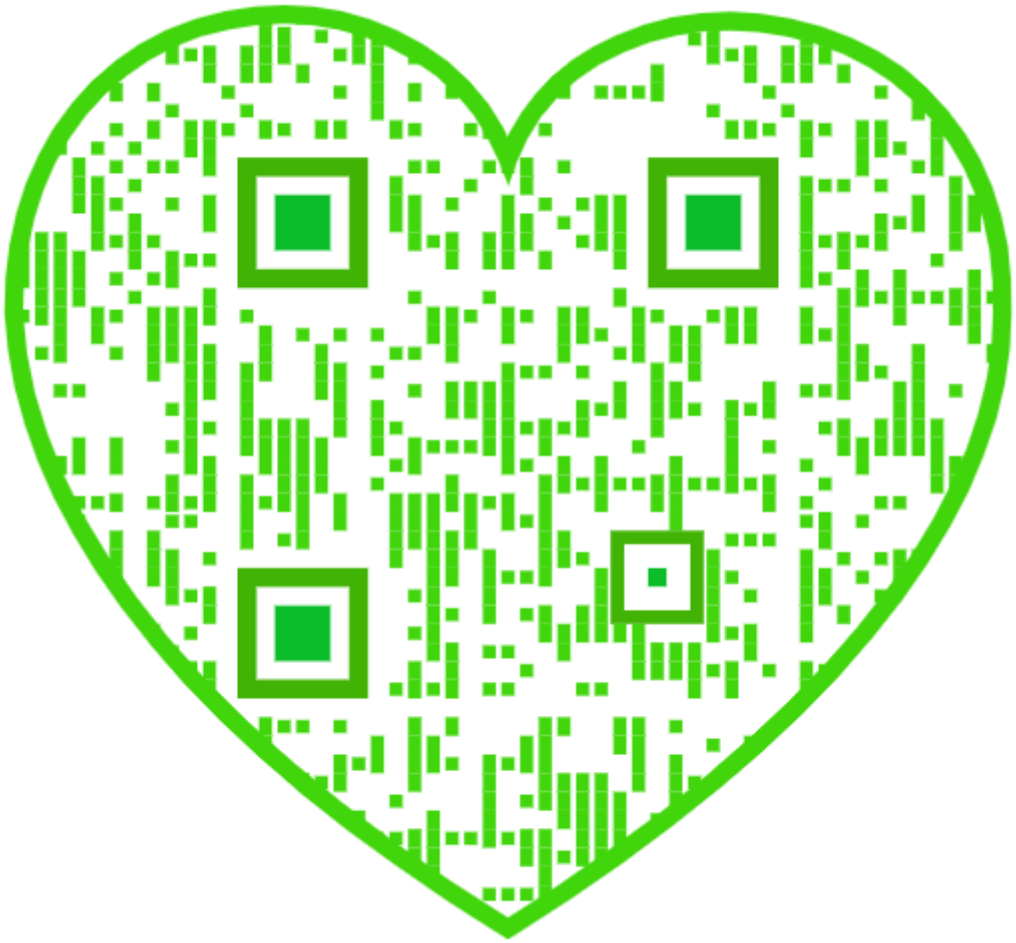

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NEW YORK, SATURDAY, NOVEMBER 7, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE NEW CUNARDERS.

The preliminary work, looking to the determination of the dimensions and the character of the motive power, of the two great transatlantic liners which are to be built for the Cunard Company has progressed so far, that we are now enabled to announce authoritatively the leading characteristics of these two remarkable ships. As regards dimensions, it may be stated that the new vessels will be so large as to completely dwarf even such huge vessels as the "Deutschland" and "Kaiser Wilhelm II." While there will be a considerable increase in the length, the new boats being about 100 feet longer than the "Kaiser Wilhelm II.," we must look to the increase in beam and draft to account for the enormous displacement of 40,000 tons which the new ships will reach. Of the fast liners, the "Kaiser Wilhelm II." is the broadest, with a beam of 72 feet, while her draft is 29 feet. The new Cunarder, however, will have a beam of not less than 80 feet and a minimum draft of between 34 and 35 feet, and the length over all will be 800 feet. From these dimensions it will be seen that the ratio of beam to length is larger than has marked the more recent transatlantic ships. Tank experiments, however, have shown that for these vessels the best speed lines can be obtained with the proportions given above.

In view of the fact that the SCIENTIFIC AMERICAN has urged that the time was ripe for the introduction of the steam turbine into the transatlantic service, we are gratified to be able to state that there is every possibility of turbine engines being installed in these vessels in place of the usual reciprocating engines. The matter has progressed so far that a special commission has been appointed to investigate the whole question of the economy of the steam turbine, and to advise as to its suitability for the new ships. The British Admiralty, which was invited by the Cunard Company to assist in the proposed investigation, have nominated as their representative the Deputy Engineering Chief of the Navy, together with the secretary who served on the Naval Boiler Committee, which has recently been carrying out such extensive and widely-known tests of the merits of the water-tube boiler. The Commission also includes the General Manager of the Cunard Company, the Engineering Surveyor of Lloyds Registry, besides several eminent engineers of the leading shipbuilding firms in Great Britain. The Commission will carry out an exhaustive series of trials, to determine the question of the steam consumption or fuel economy of the steam turbine when fitted to merchant ships. The results of the Admiralty trials of the new torpedo boat destroyer "Velox," which carries the Parsons steam turbine, will be placed at the disposal of the company, and it is probable that special trials of the steam turbine passenger ships that have lately been constructed for the Channel service will be carried out for the benefit of the Commission.

The determination to consider seriously the installation of turbines on these important vessels has been prompted by the universally good results obtained on the turbine passenger vessels now in service, and also by the difficulty of securing satisfactory shafting of the great size that would be necessary to transmit the total horse power of from 70,000 to 75,000, which will probably be indicated on these vessels when they are being pushed to their maximum speed. The leading firms, both in Great Britain and Germany, that manufacture steamship shafting, have expressed themselves as fully alive to the difficulty of finding satisfactory reciprocating engine shafting that would transmit 25,000 horse power per shaft, the largest power that any shafting is at present called upon to transmit being about 18,000 horse power. By the use of the turbine, with its high rotative speed, the dimensions of the shafting would, of course, be proportionately reduced, with well-known beneficial results. Another powerful argument in favor of the turbine has been the fact that while reciprocating engines of the size necessary would call for about 10,000 tons weight of machinery, the total weight necessary, were turbines used, would be only about 7,000 tons. Consequently, the size, the displacement, and cost of the ships could be reduced by 3,000 tons without affecting their revenue-earning capacity; for the passenger accommodation would remain the same. Furthermore, in view of the fact that steam turbines of 10,000 indicated horse power are now being built on the Continent under a guaranteed steam consumption of less than 9 pounds per indicated horse power, it will be seen that the great saving in weight and space due to the use of turbines can reasonably be expected to be made without any sacrifice of steam economy. Even if we admit that reciprocating and turbine engines would exhibit about the same steam economy, the turbines would show a great reduction of oil consumption and repairs, both costly items in the engine room of the high-speed liner; while there would be a considerable reduction in the necessary staff of engineers. This is proved by the fact that even in the relatively small Channel steamers "Queen" and "Brighton," which are not of more than 2,000 tons displacement, there are three fewer engineers required in each engine room than would be carried if the engines were of the normal type.

The report of the turbine commission, which will be delivered probably within a couple of months, promises to be one of the most valuable documents of the kind that have recently been made public. As to the speed of the new ships, there will be a call for 25 knots sustained sea speed, with probably a trial speed of 26 knots per hour. The vast size of these vessels, the enormous momentum which they will have when running at full speed, will render them comparatively independent of adverse weather; and it is quite within the range of possibility that a ship leaving New York at 10 o'clock on Saturday morning will be in the Mersey early in the afternoon of the following Thursday.

STEEL-CONCRETE CONSTRUCTION.

A most important addition to the list of available building and structural materials, and one that is making rapid headway in favor, is the combination of steel and concrete, whose successful introduction and exploitation is to be credited to French engineers. The reputation of concrete as a building material is almost as old as history itself; but although this material is admirably adapted for structures in which the stresses to which it is subject are chiefly those of compression, it has always been recognized that its lack of tensile strength placed a strict limit upon its usefulness. Thus, it is a most excellent material for foundations, retaining walls, and pavements, and for monolithic construction in the building of breakwaters and other subaqueous work, and in the construction of great reservoir dams. When it comes to using concrete for structures that are subjected to a transverse stress, or indeed any stress but that of direct compression, the material becomes altogether unsuitable. Thus, although the upper half of a concrete beam might have ample strength to resist compression, its lower half, unless the section were made of an impossible bulk, would fail for lack of tensile strength. The French engineers, however, have very cleverly overcome the difficulty by a judicious incorporation of steel rods or other structural steel shapes within the mass of concrete, in such a way that the finished member is reinforced in that portion of it that is subject to tensile stresses. Thus, in the case of a beam, or of an unsupported floor surface, the steel rods are laid in place near the under surface, and the concrete mass is then formed in around them, the proportion of the section of the steel to the concrete being calculated to bring the tensional strength of the concrete up to the required point. The frictional contact, or "bond," between the steel and concrete is estimated, where the work is properly done, at several hundred pounds per square inch, and the result has been proved to be eminently satisfactory. In the building of arch bridges, it has been found possible to make such a reduction in the thickness of the arches that a steel-concrete arch compares favorably in lightness and grace of appearance with an all-steel arch bridge. The new construction is finding a wide variety of uses, and reinforced concrete columns are now being used in active competition with all-steel columns in building construction. A notable instance of the great utility of the system is found in our own Rapid Transit tunnel in New York, where the method of building the walls and roof of I-beams with concrete arches turned in between, has given way to a new type of steel-concrete work in which the walls are finished off with plane surfaces. The cost of materials is considerably less, and, because of the simplicity of the system of erection, there is necessarily a great saving in labor. The new construction is one of the most interesting that has been introduced of late years into general engineering and building work, and there is no doubt that it will serve to break the practical monopoly which steel has held in certain lines of engineering construction.

NEW FIELD GUN FOR THE BRITISH ARMY.

There is to be introduced into the British army, to replace the types already in vogue, a new field gun, the features of which are accelerated quick firing, efficiency, strength, and mobility. When the number of batteries was increased some time ago, the new German quick-firing field gun was adopted, as it was considered that it was the best in existence. These guns, however, have proved a miserable failure. They were accurate enough so far as their actual shooting was concerned, but they were not sufficiently quick-firing in the sense in which quick firing is at present implied, and they were of too light construction. Breakdowns were frequent with the gun carriages, and they had practically to be rebuilt at the government arsenal before they were fit for hard service.

A short while ago the British War Department secured two of the most recent field guns now used in the French army. Modifications were carried out and improvements effected to adapt them to the exigencies of the British army, and from the experiments that have been carried out upon the government proving grounds, they have proved eminently successful, and superior to any other quick-firing field guns used by other countries, with the exception of France.

The new weapon possesses four salient features in its design: the improved breech action, increased range, greater rapidity of fire, and perfect absorption of the recoil. The extreme range is 10,000 yards, and the rapidity of fire is 29 rounds per minute. Owing to the improved time-fuse that has been devised, shrapnel fire is now rendered effective at a range of 6,400 yards, which is a tremendous advance upon any field gun in use in the British army at the present time. The interrupted screw principle in the old type of breech action has been entirely dispensed with. The old threaded, coned steel breech block necessitates intricate and delicate mechanism in order to cause it to work efficiently, and furthermore requires skillful manipulation in the insertion of the shell to prevent the burring of the thread. This care impeded celerity in loading and firing to an appreciable extent. The new breech is that, invented by Col. Deport of the French artillery, and in the place of the threaded cone block, there is a plain steel disk swinging on a pivot, and operated by a system of levers and ratchets. A crank handle is connected to this steel disk, and when this is pulled, the disk slides round upon the pivot, admitting the insertion of the projectile into the bore, while a reversion of the opening action closes the breech ready for firing. Directly the disk swings to and closes the breech, an automatic device fires the gun. This is a very simple contrivance, and expedites the rapidity of discharge to a very marked extent, as the whole operation of loading and firing can be accomplished in about two seconds. At a trial of this weapon in the French army, a gunnery detachment fired eight rounds in fifteen seconds, and thirty rounds have been discharged in the space of one minute by expert gunners. Another advantage of this system lies in the fact that if it is desired to maintain a slow rate of firing, it is only necessary to throw the automatic firing mechanism out of gear, which operation is effected by a simple device, and the gun is then fired in the orthodox manner by the pulling of a lanyard, which actuates the striker. When the shot has been fired, as the breech is opened, an extractor comes into action, grips the cartridge remaining in the breech, and jerks it out, so that the gun is ready for the immediate insertion of another charge. Fixed ammunition, consisting of the cartridge and shell joined in one piece, is employed for this weapon.

The hydro-pneumatic brake for the absorption of the recoil is also utilized. This mechanism comprises two almost vertical pistons, which are partially filled with a mixture of glycerin and water. When the gun is discharged, it rises under the force of the shock, and in doing so the mixture in the pistons, together with a certain amount of air which serves as a buffer or cushion, is forced through small holes in the piston head, and the resistance offered to the liquid, together with the weight of the weapon itself, is such that the shock of the recoil is entirely absorbed. After the shock has been thus taken the gun returns to its normal position for loading and firing again. The advantage of this system is that the gunnery detachment need not retire from their positions during the moment of firing, but can maintain their ground with absolute safety. By this means no loss of time in loading is incurred.

The government war authorities have carried out most severe trials with this weapon, but so successfully has it emerged from the ordeal, that the field artillery batteries are to be equipped with it at once. Furthermore, owing to the unique success of the breech mechanism, an effort will be made to adapt it to the requirements of the heavy guns carried on cruisers and battleships.

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THE DEATH OF PROF. R. H. THURSTON.

Prof. Robert H. Thurston died suddenly on October 25, at the age of sixty-four. Cornell University has lost one of the most distinguished members of its faculty, and the country one of its foremost mechanical engineers.

Even in early childhood he exhibited those tastes for applied sciences which later he developed to so remarkable a degree. He may be said to have been born an engineer. His father was a steam-engine builder of some note; and from him Dr. Thurston received his early training in steam engineering. He graduated from Brown University in 1859 with the degree of Bachelor of Philosophy. When the war broke out in 1861, he joined the Engineer Corps of the United States Navy, and served with distinction throughout the entire conflict. From 1866 to 1871 he occupied the chair of Natural Philosophy at the United States Naval Academy. Subsequently he became Professor of Engineering at Stevens Institute, where he remained until he received a call to Cornell in 1885.

Sibley College of Cornell University, as we know it to-day, is peculiarly the work of Dr. Thurston. In 1886 the number of its graduates was but eight; in 1903 it was about one hundred and twenty. For a foundation and main cornerstone he found the admirable work which had been done up to that time, chiefly under the direction of Prof. J. L. Morris. There remained, however, the superstructure of professional and graduate courses in the main lines of mechanical engineering and in its important specially differentiated branches. To the great work of planning and constantly elevating and improving these curricula he devoted his best thought and effort for the last 18 years, the period of his life richest and best in mature thought and judgment, and without abatement in vigor and freshness of mind. In a real sense, the college may be regarded as a monument to the organizing skill of Dr. Thurston, and a realization of his high ideals of engineering training. He found Sibley College in difficulties of various sorts; he left it one of the foremost engineering schools in the country.

Readers of this journal will remember him as a writer whose limpid style lent a peculiar charm to his papers. He had a happy faculty of expressing himself with a lucidity that is only too rarely found in present-day technical writing. Of the twenty volumes which he wrote, the more important are his "Manual of the Steam Engine," "Manual of Steam Boilers," "Engine and Boiler Trials," "History of the Steam Engine," and "Materials of Engineering." His published professional and scientific papers number nearly three hundred. As an inventor Dr. Thurston was known for his magnesium burning lamps, army and navy signal apparatus, various forms of testing machines for iron and other metals, some improvements on the steam engine, and various scientific and engineering apparatus. In scientific research his most noteworthy work was done in investigating the commercial economy of the steam engine, and in determining the useful qualities of various alloys.

The Editors of the SCIENTIFIC AMERICAN recall him as a friend whose sympathetic and kindly personality and whose vast fund of technical knowledge made him a more than welcome visitor.

THE HEAVENS IN NOVEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

It is obvious that, when a planet has well-defined permanent markings on its surface, its period of rotation can best be determined by observation of these. But Mars and the Moon are the only bodies in the solar system which have easily-visible markings of this sort. It is for this reason that they are the only bodies in our system (besides the Earth itself) whose periods of rotation are known to a high degree of precision.

Jupiter and the Sun show conspicuous markings, but they are not permanent—though the "great red spot" on Jupiter has lasted a good many years. Different spots, however, both on Jupiter and on the Sun, are found to have different periods of rotation. In fact, the sunspots show a steady increase in their period as we go from the solar equator toward the poles, while each of the principal "belts" of Jupiter has its own peculiar time of rotation, the equatorial belt moving most swiftly. In these cases we cannot be sure which of the markings that we see, if any, represent the true rotation period of the main mass of the interior.

The other planets are much more untractable. Mercury, to be sure, has shown to the keen eye of Schiaparelli a few faint but permanent markings, which seem to show conclusively that he keeps always the same face to the Sun, and consequently rotates once in 88 days. But Venus, Uranus, and Neptune show no markings at all, and Saturn rarely has any that can be used to determine his rotation. On rare occasions, however, a mark appears.

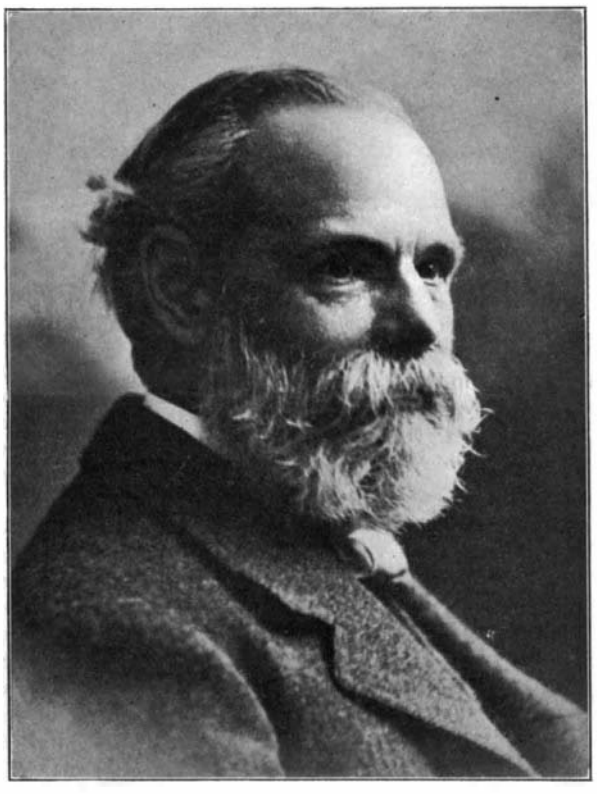
The first notable instance of the sort was in December, 1876, when Prof. Asaph Hall observed a bright spot near Saturn's equator. It was found to have the rotation period of 10h. 14m.

A conspicuous white spot appeared on the planet this year, in the "north temperate zone," to use a term of ordinary geography.

It was discovered by Prof. Barnard at the Yerkes Observatory on June 15, and has since been followed by many observers. It is oval in form, some fifteen or twenty thousand miles long by about two-thirds as broad, and has gradually been fading away. Its period of rotation is about 10h. 38m.

The difference between the rotation period of this spot and that of the one seen by Prof. Hall is rather surprising. Both were too well observed to admit any doubt as to the facts, and it seems clear that on the surface of Saturn, as well as of Jupiter, there must be currents of matter moving with different velocities. But as the diameter of Saturn is over 70,000 miles, a simple calculation shows that the two spots, if they both existed at once, would move past one another on the planet's surface at the rate of 1,600 miles an hour. How the currents on the planet's surface can have such great speed is rather puzzling. No satisfactory explanation has yet been offered, at least so far as the writer is aware. But what shall we do in the case of the remaining planets, which show no markings at all? How can we get any idea how rapid their rotation is?

One answer is afforded us by the spectroscope, by taking advantage of the well-known principle that the lines in the spectrum of a body which is approaching us are shifted toward the violet, while if it is receding, the lines are displaced toward the red. (Though the planets do not shine by their own light, the same principle applies to the light which they reflect.)



THE LATE PROF. R. H. THURSTON.

Now suppose that we take a photograph of a planet's spectrum, arranging the slit of our instrument parallel to the planet's equator. Then, if the planet is in rotation, the light at one end of the slit will come from one edge of the planet, say the one that is moving toward us, while the other end of the slit will get light from a part of the surface that is receding from us. It follows that the lines in the photographed spectrum will be shifted toward the violet at one end and toward the red at the other; in other words, they will cross the band of spectrum obliquely instead of at right angles. Other things being equal, the amount of tilt of the lines is proportional to the speed of the planet's rotation.

By this method the rotation period of Saturn could be obtained at any time independent of the infrequent markings on his disk, and, in fact, its first use was to investigate the rotation of Saturn's rings, as has already been told in these columns.

Recently the same thing has been done for Venus. Some results published a couple of years ago by Dr. Bilopolsky, of Pulkowa, seemed to indicate that Venus rotated in about a day. But this summer there has appeared an account of a long and very careful series of observations made at the Lowell Observatory, in Arizona, with a very powerful instrument, which show no sensible evidence of any rotation, and demand for their explanation a period of rotation at least some weeks in length. So the evidence is at present in favor of a long rotation period for Venus. The theory that she always turns the same face toward the Sun, and so rotates once in 225 days, seems as likely as any.

In the cases of Uranus and Neptune, it is difficult, if not impossible, to apply the spectroscopic method, on account of the faintness of their light. Besides this, Uranus is at present in a position where his pole is turned almost directly toward us, so that, if there were any markings on his surface, we would see them simply turn round and round like a wheel, scarcely approaching us or receding from us at all. The spectroscopic method therefore fails. However, there is still another method that can be used, depending upon the mathematical theory of the motion of their satellites.

If a planet is perfectly spherical, the point in the orbit of any satellite where it comes nearest to the planet will remain fixed, but if the planet is flattened at the poles, this point of nearest approach will move slowly round the orbit, at a rate depending upon the amount of flattening of the planet. Now the amount by which the planet is flattened at the poles depends on its rate of rotation. As the elevation between the two involves also the distribution of density in the interior of the planet, we cannot derive an exact value of the rotation period from the flattening; but we can get a pretty good idea of its magnitude.

In a recent paper, Prof. Bergstrand, of Upsala, has made a study of the orbit of one of the inner satellites of Uranus. He finds that the point where the satellite comes nearest the planet is actually in motion, and comes to the conclusion that it is probable that Uranus is flattened at the poles by about 1-17 (more or less) of his whole diameter, from which it would follow that the planet's rotation period is about twelve hours.

A similar investigation of the satellite of Neptune, made some three years ago by Prof. Brown, of the Naval Observatory in Washington, led to the conclusion that Neptune is also perceptibly flattened at the poles, and that its period of rotation is some fifteen hours, more or less.

THE HEAVENS.

The brilliant constellations of winter are now returning to our skies. At our usual hour—9 o'clock on the 15th—Orion, the finest of them all, has just risen in the east. Gemini is north of him, and also low down. Taurus and Auriga are above these two. Perseus and Cassiopeia lie in the Milky Way above Auriga, and Andromeda and Pegasus extend toward and beyond the zenith. Cygnus, Aquila, and Lyra brighten the western sky.

The southern constellations are dull—Eridanus in the southeast, Cetus due south, and Aquarius and Capricornus west of it; but the bright star Fomalhaut, and the still brighter planets Jupiter and Saturn, diversify the southwestern sky.

The Great Bear and Draco are below the pole, and not very conspicuous.

THE PLANETS.

Mercury is morning star until the 21st, when he passes through superior conjunction—almost literally behind the sun—and becomes an evening star. He is visible for the first few mornings of the month, rising more than an hour before the sun, but he does not remain in sight for more than about a week.

Venus is morning star in Leo and Virgo, and is exceedingly conspicuous. On the 28th she reaches her greatest elongation west of the Sun, 46¾ degrees. All through the month she rises before 4 o'clock. On the morning of the 15th she is in conjunction with the Moon. At 10 o'clock she will be almost above the Moon, at a distance of about two degrees—four times the Moon's diameter. This is a very good time to look for her by daylight.

Mars is still an evening star, but, being very far south in Sagittarius, he is far from prominent. He sets at about 7:30 P. M. in the middle of the month.

Jupiter is conspicuous in the early evening. He is in Aquarius, and comes to the meridian at about 7:30 on the 15th. Those who have telescopes of any size can see an interesting sight on the evening of the 24th, when his first and fourth satellites are eclipsed or occulted behind the planet, and the third satellite transits in front of it.

Saturn is evening star in Capricornus. He sets at about 11 P. M. on the 1st, and 9 P. M. on the 30th. Uranus is in Ophiuchus, too near the Sun to be seen. Neptune is in Gemini, and comes to the meridian at 3 o'clock in the morning on the 15th, too late for convenient observation by amateurs.

THE MOON.

Full moon occurs at midnight on the 4th, last quarter at 10 P. M. on the 11th, new moon at midnight on the 18th, and first quarter at 1 A. M. on the 27th.

The Moon is nearest the Earth on the 10th, and farthest away on the 25th. She is in conjunction with Neptune on the 8th, Venus on the 15th, Mercury on the 18th, Uranus on the 21st, Mars on the 22d, Saturn on the 24th, and Jupiter on the 27th. None of these conjunctions is remarkably close.

About 11 o'clock in the evening on November 6 the Moon passes close to the bright star Aldebaran. As seen from the northern part of the United States, she will actually occult the star for a short time, but observers in the south will see her pass clear of it.

Cambridge, England.

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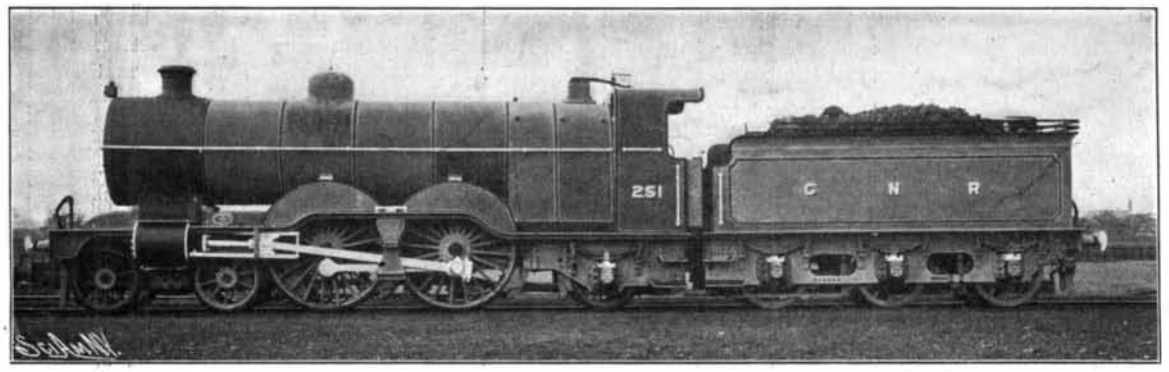
SOME POWERFUL ENGLISH EXPRESS LOCOMOTIVES.

Although the awakening of the British locomotive builder to the necessity of turning out more powerful engines has come rather late, there is no denying that a remarkable and very radical change is taking place in this respect in locomotive practice in Great Britain. During the past two decades the weight of trains in Great Britain has increased very much faster than the size and power of the engines. This is proved by the fact that the most important express trains are in many cases hauled by two engines, a practice which for many reasons is not desirable.

Now that the locomotive superintendents have set about the work of introducing larger engines, they are turning out some of the most powerful and handsome locomotives that are to be found in any country. Seeing that America was the pioneer in the development of the big engine, it is natural that the new English locomotives should correspond in general design to those which have proved their efficiency in hauling heavy trains at high speed on this side of the water.

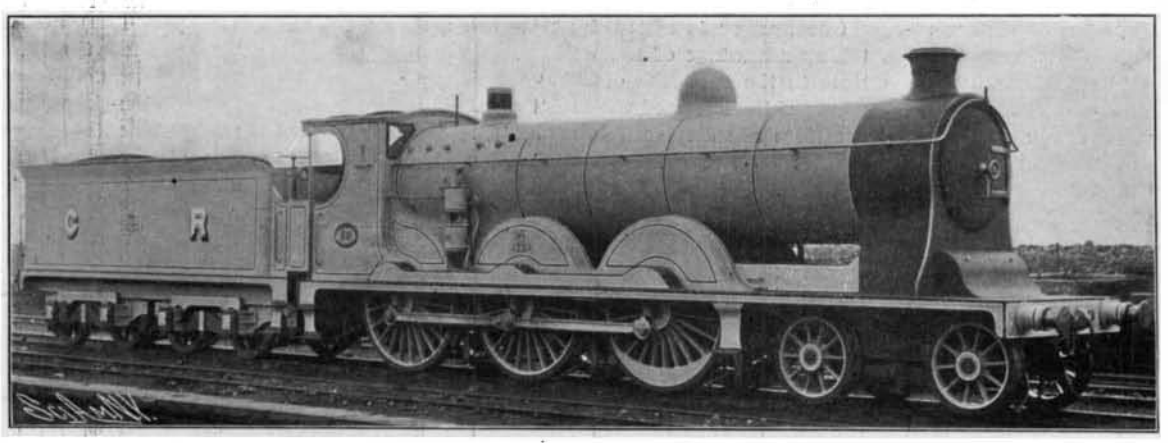
We present illustrations of two of the largest and most powerful of these engines; one, a four-coupled express engine designed by Mr. H. A. Ivatt, the locomotive superintendent of the Great Northern Railway, and the other a six-coupled express engine designed by Mr. John F. McIntosh, the locomotive superintendent of the Caledonian Railway. The Great Northern engine is the latest of a class of which many are now being built for hauling the long and heavy express trains that run from London to the north by the East Coast route. It is of what is known in this country as the Atlantic type, the engine being carried upon ten wheels, namely, a four-wheeled truck, four coupled drivers, and a pair of trailers beneath the firebox. The weight is distributed as follows: 19 tons on the truck, 36 tons on the drivers, and 14 tons on the trailers, making a total of 69 tons for the engine. The tender, which is carried on three axles, has a capacity of 5 tons of coal and 3,600 gallons of water. It is provided with a scoop for taking up water from the troughs between the rails. The total weight of the engine and tender, when fully loaded, is 118 tons. The most marked development in current English locomotive practice is the tendency to greatly increase the size and heating surface of the boilers. Thus, the present boiler, which is 5 feet 6 inches in diameter in the barrel, and carries a wide firebox extending beyond the frames, has a grate area of 31 square feet, and a total heating surface of 2,500 square feet. This should be compared with the well-known Sterling engines, many of which are still running on this road, which, with single drivers of 8 feet diameter, carried a boiler with scarcely half as much heating surface, or a trifle less than 1,200 square feet. The cylinders are 19 inches in diameter by 24 inches stroke, and the driving wheels 6 feet 8 inches in diameter, the steam pressure being 175 pounds to the square inch. The total wheel base of the engine is 26 feet 6 inches, of which only 6 feet 10 inches is actually rigid, for the reason that the front end of the engine is carried on a swing-link truck, and provision is made for lateral play of the pair of carrying wheels under the firebox.

The other illustration is of a six-coupled express engine, designed for heavy work over the Caledonian Railway, which forms the last link of what is known as the West Coast route to the north from London. This is considerably the largest express engine in Great Britain, and it was designed to enable a single engine to take heavy express trains from Carlisle to the north over heavy grades which include 10 miles of upgrade over the Brattock summit, where there are 10 miles of 1 in 73 and 1 in 75. When it is considered that the trains are from 340 to 400 tons in weight, it can be understood that in doing away with the double-header, it is necessary to design a locomotive of exceptional weight and power. The engine has six wheels coupled and is inside-connected. The cylinders, which are 21 inches in diameter by 26 inches stroke, are located between the frames underneath the smokebox and connect to the leading axle. The boiler has a firebox 8 feet 6 inches in length and contains over 2,400 square feet of heating surface, although, had the tubes been packed as closely as is customary, the heating surface would have been about 3,000 square feet. But in order to provide ample space for the generation of steam the diameter of the tubing was graduated, the largest sizes being placed at the bottom of the boiler. The result has been very satisfactory, the boiler supplying sufficient steam for the heaviest demands of the 21-inch cylinders. The driving wheels are 6 feet 6 inches in diameter, and they carry a total load of 61½ tons. The total weight of the engine is 83 tons. The tender, which is carried upon two four-wheeled trucks, has a capacity of 6 tons of coal and 5,000 gallons of water. The total weight of the engine and tender when in working order is about 160 tons.



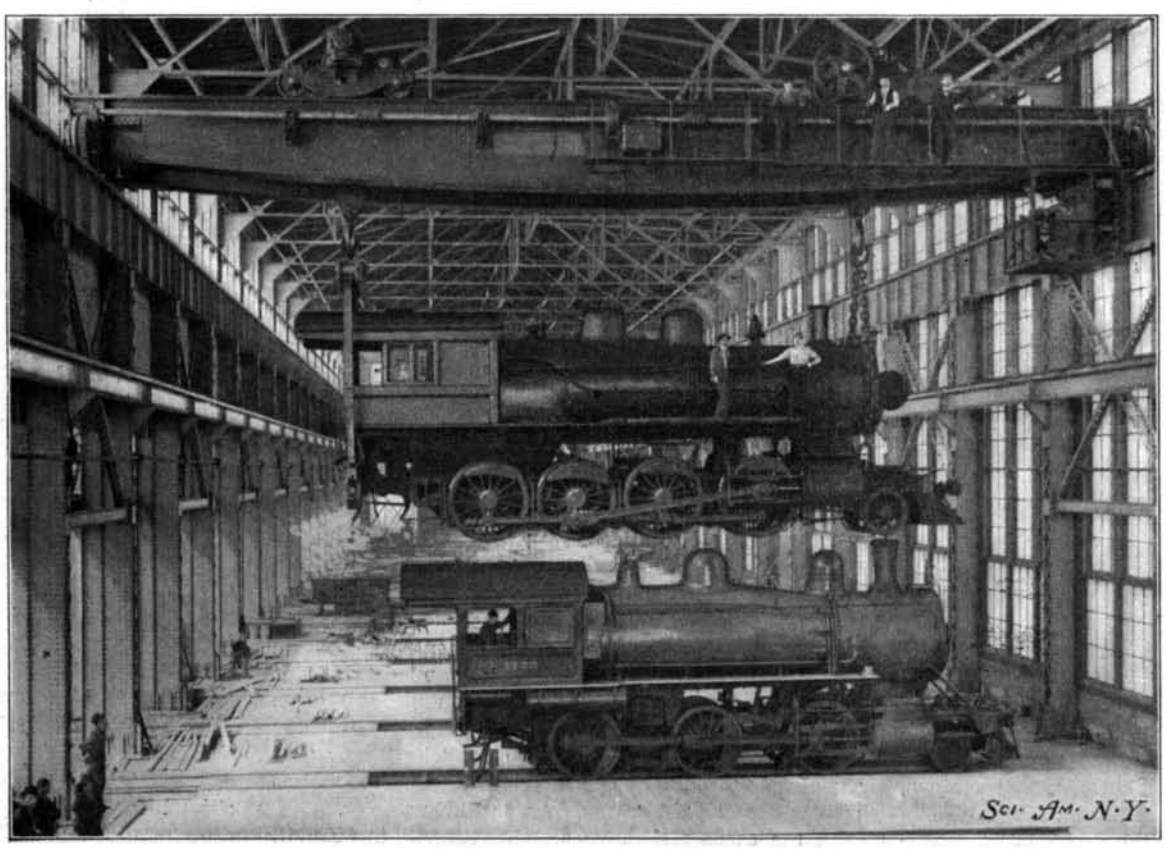
Cylinders, 19 by 24; driving wheels, 6 feet 8 inches diameter; steam pressure, 175 pounds; heating surface, 2,500 square feet.

NEW ATLANTIC TYPE EXPRESS ENGINE FOR THE GREAT NORTHERN RAILWAY, ENGLAND.



Cylinders, 21 by 26; driving wheels, 6 feet 6 inches diameter: heating surface, 2,400 square feet.

NEW SIX-COUPLED EXPRESS ENGINE FOR THE CALEDONIAN RAILWAY, ENGLAND.



LIFTING AN EIGHTY-TON LOCOMOTIVE WITH A TRAVELING CRANE.

The Manipulation of Liquid Gases.

In the course of a recent lecture on hydrogen at the Royal Institution, Prof. Dewar employed, for the first time in public, a new device which represents an important improvement in the manipulation of liquid gases, and which therefore he anticipates will soon be adopted in other low-temperature laboratories. Its purpose is the transference of such liquids, in particular of liquid hydrogen, from one vessel to another without loss by volatilization. It is a development of the Dewar vacuum vessels, and consists essentially of a vacuum-jacketed conduit, a narrow tube, which actually conveys the liquid, being inclosed in a larger tube, and the intervening space exhausted of air. This double tube is bent into a U-shape, and one end of it passes through an india-rubber stopper in the vessel from which the liquid is to be drawn off. So long as this end of the tube is above the level of the liquid, nothing issues from the orifice except a little hydrogen vapor, but if it is lowered into the liquid the evaporation of the hydrogen in the vessel affords sufficient pressure to force the liquid out along the tube, the flow being immediately stopped when the tube is lifted again. For the first time in public also, Prof. Dewar, by the aid of liquid hydrogen, showed fluorine liquefied and solidified, the element being seen first as a colorless gas, then as a yellow liquid, and finally as a white solid.

THE HANDLING OF LOCOMOTIVES.

This photograph, which was recently taken in the shops of the Lake Shore and Michigan Southern Railway Company at Collinwood, Ohio, strikingly illustrates the lifting power of the modern electric crane used in shop practice. The plant referred to includes in its machinery a 100-ton crane of the Niles-Bement-Pond pattern. The crane is operated by two 50-ton trolleys, and travels the length of the shop upon a steel track supported on girders built into the wall. It is equipped with two hoisting motors, each representing 45 horse power, and is sufficiently powerful to raise the heaviest load which can be attached to it, at a speed of 10 feet per minute. The crane can be moved along the building at the rate of 150 feet a minute with a load of 80 tons, and at an increased rate of speed with correspondingly lighter weight. The locomotive which is being handled in the picture is one of the large consolidation freight engines in use on the Lake Shore system, and represents a weight of about 80 tons. When the picture was taken, it was being moved at the rate of about 100 feet per minute.

The Post Office Department has prepared a ruling to the effect that cremated bodies should be classed as merchandise, and should pay the regular rate of one cent for four ounces. As a result of his decision, four air-tight tin canisters, containing the cremated remains of a family, shipped from New York to San Francisco, were forwarded from the Washington post office, where they had been held up pending a determination of the postage rates for the journey.

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STELTJE'S TYPE-PRINTING TELEGRAPH.

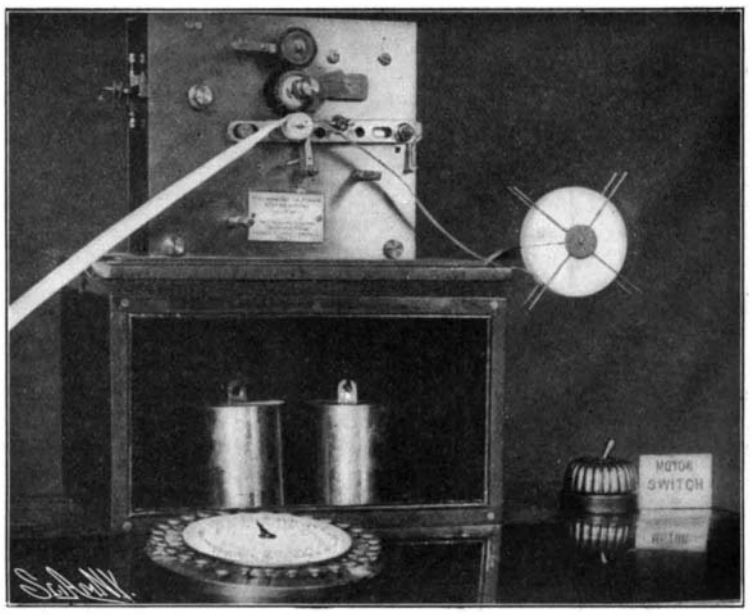
The leading features of the Steltje's type-printing telegraph, improved by the Type Printing Telegraph Corporation, are that no batteries are required, no expert telegraphists needed, and the message is printed automatically at both ends of the lines.

The sending part of the Steltje's telegraph recorder is essentially the same as the well-known Wheatstone A B C instrument, the keys being arranged round a dial on which are marked the characters to which they correspond.

The receiver, however, differs in that the letters are printed on a continuous tape instead of being merely pointed to by a moving needle, which cannot easily be followed if worked beyond a certain rate. Hence no operator is required at the receiving end. The instrument, like the ordinary tape machine, prints its message in plain characters, but will work with currents of 8 milliamperes generated by a small magneto. The keyboard permits of 58 different characters being dispatched. The apparatus can be used on an ordinary telephone line without in any way interfering with its use for speaking over.

The receiving instrument consists of a train of clock work actuating a typewheel and controlled by two magnets. One of these is called the busy magnet, and the other the lazy magnet. The current operating the instrument is a high-tension alternating current generated either by turning a handle, by working a pedal, or by a small electric motor. As long as the current is kept flowing, the receiving instrument remains at rest, but on the depression of one of the keys in the transmitter, pulsations are transmitted along the line to the busy magnet, and rotate the typewheel synchronously with the rotation of the needle of the transmitter. The pointer of the transmitter comes to rest opposite the key depressed and the current is cut off. It is this cutting off of the alternating current altogether which operates the lazy magnet, allowing its armature to fall away and thereby releasing a second train of clockwork which brings the paper into contact with the typewheel to print a letter. There is an exceedingly beautiful arrangement for changing from letters to figures. The key opposite the word "Figures" is depressed on the transmitter, whereby the typewheel at once takes up a corresponding position at the receiving end. No impression takes place because there is no letter on the typewheel at that particular spot, but the typewheel carries a small projection on its axis, which in this particular position is caught by a projection on the printing lever, or lever which lifts the paper into contact with the typewheel, and the typewheel is thereby shifted longitudinally on its axis and prints figures until it is returned to its letter-printing position in a similar way. The method of obtaining synchronism is very interesting. Of course it is necessary that the typewheel and the pointer on the transmitting dial should revolve accurately together and should start together from the zero point. This is accomplished by means of a lever at the receiving end, which slowly rises as the typewheel revolves and after three or four revolutions gets into the path of a projection on the typewheel shaft, thus stopping it in the zero position. The first movement of the printing lever returns the lever to its normal position and allows the typewheel to rotate again to get into position for the next letter.

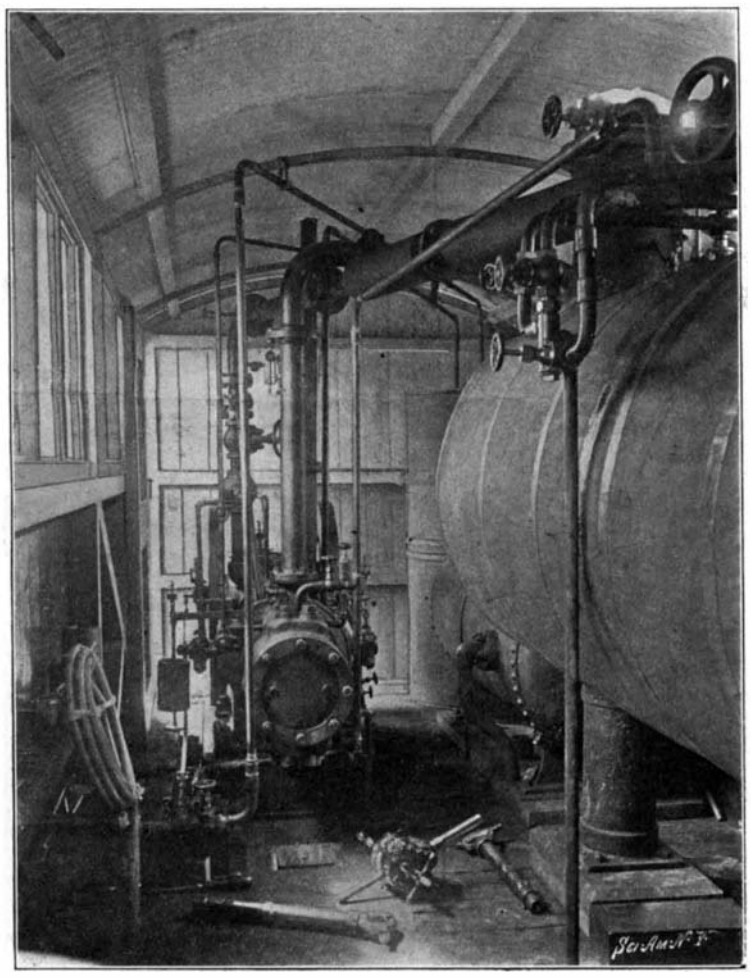
The advantages—not merely claimed, but practically established—are simplicity of working, celerity, and accuracy. Mr. Steltje's novel and ingenious instrument possesses moreover the great advantage of providing a record of all that passes at each end of the circuit simultaneously for subsequent reference and confirmation, and thus furnishes the missing link so long desired. It appears that the instruments work admirably in series, so that a message can be transmitted from one station to six or more stations at once, at all of which a printed record will be produced; and moreover, owing to the very small current required to operate the mechanism, it appears that messages can be sent along an uninsulated wire lying on the ground. Messages can be dispatched at a very rapid rate; the instrument weighs no more than 28 pounds. Last October the invention was tried by the German military authorities with excellent results. In Vienna 50 soldiers were one afternoon instructed in the working of the instrument, and it was not found necessary for any expert engineer to interfere during the whole of the trials, which lasted a week. The fact also that Steltje's apparatus can be worked over their cavalry wire cannot be too highly appreciated. The necessary wire for purposes of telegraphic communication can be carried by men on the march. The instrument has been adopted by most of the continental armies, and has become popular in Austria, Siam, Spain, Nicaragua, etc. This apparatus is one likely to be also useful in large offices where messages have to be sent privately from one room to another which may be far away, without the disadvantage of a personal journey being necessary. The system would seem to have a good prospect of success in the commercial world, because enormous possibilities are undoubtedly open for the utilization of this invention.



STELTJE'S TYPE-PRINTING TELEGRAPH.

French Academy Prizes.

At the annual public session of the Academy on October 26, President Perrot announced a number of prizes, including $1,400 for experiments at the Sorbonne Laboratory to settle the differences between French and American scientists in connection with electrodynamics. The Academy awarded the prize of $20,000 for the most remarkable scientific work to Dr. Roux, who continues to carry out the work begun by the late Prof. Pasteur. Dr. Roux accepted the prize on condition that the amount be devoted to the scientific investigations of the Pasteur Institute.



INTERIOR OF THE REPAIR-CAR, EQUIPPED WITH PNEUMATIC TOOLS.

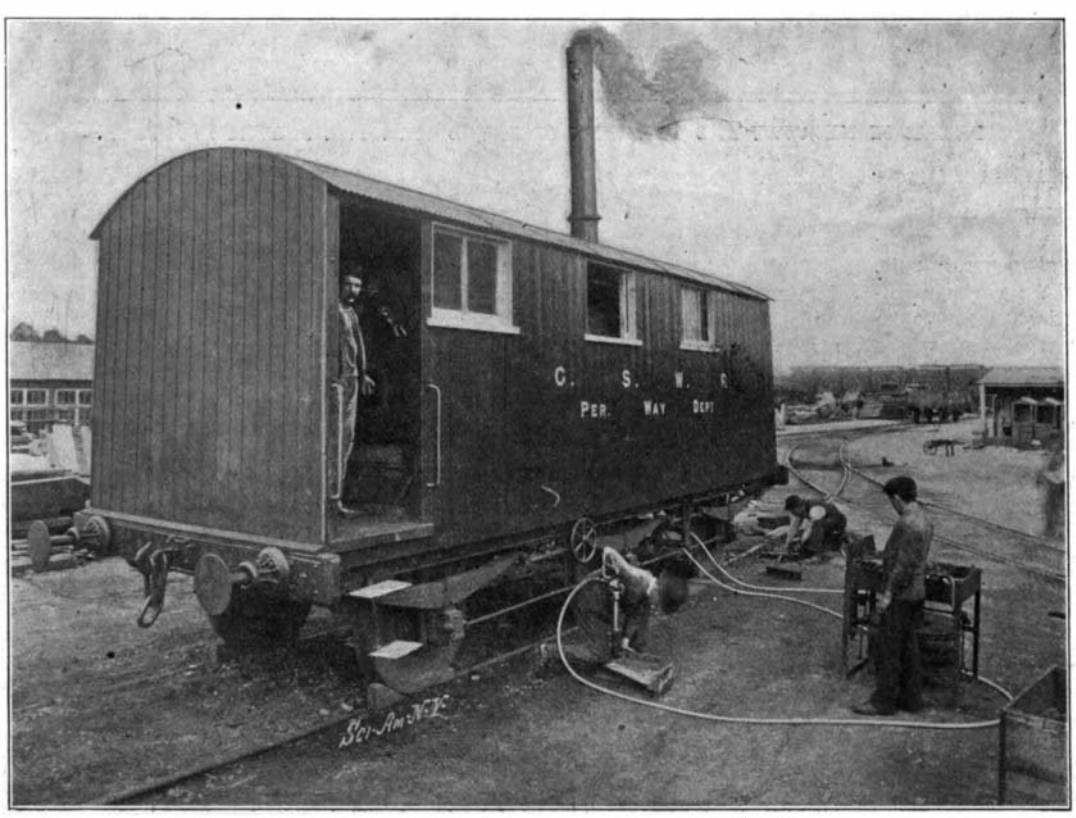
A PORTABLE PNEUMATIC TOOL OUTFIT FOR RAILROADS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A compact and well-equipped complete portable pneumatic tool installation has recently been designed for the Great Southern & Western Railroad of Ireland by the International Pneumatic Tool Company. There are many phases of work and repairs upon a railroad for which such a pneumatic outfit is peculiarly adapted, notably the repair of bridges, relaying of the rails, and drilling operations, which can be more expeditiously and economically carried out by the aid of pneumatic tools than by the ordinary means of manual labor. The only difficulty in such work is the provision of the necessary air-compressing plant to operate the tools. The Great Southern & Western Railroad have had the car which we illustrate herewith specially constructed and fitted up with a complete installation necessary for emergency purposes.

The power for driving the air-compressing plant comprises a 12-horsepower semi-portable boiler, complete with steam injector and the other necessary fittings. The air compressor is of the horizontal straight-line, steam-driven type, with water jacket and automatic speed and pressure regulators, and it has a capacity of 134 cubic feet of free air per minute. This part of the plant is mounted on a sub-base fixed on the floor of the truck. Beneath the floor of the wagon is suspended a steel air tank. This reservoir is 6 feet in length by 2 feet 6 inches diameter, and is fitted with a flexible hose. The plant in the wagon itself also comprises a water-circulating tank, which for economy of space and weight fulfills a dual purpose—cooling the air-compressing cylinder and feed-water tank for the steam engine boiler.

The pneumatic tools provided with the plant consist of two long-stroke hammers capable of closing down rivets of one inch diameter, and two pneumatic holders for use with them; two No. 2 "Little Giant" drills for boring holes up to 1¼ inches diameter, several lengths of ½ inch metallic covered flexible hose, to enable the tools to be operated at a distance from the vehicle, air filters, air-cocks, hose-clips, etc. The plant, which has been in operation for some weeks, has proved a great benefit for general and temporary work, both in the saving of labor, the expedition of the work in hand, and cheapening of the



A PORTABLE PNEUMATIC TOOL OUTFIT FOR USE IN RAILWAY-BRIDGE REPAIRING.

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cost of repairing. In our illustration the plant is shown in use for bridge-repairing work, for which it is most eminently suited.

Such installations are useful in sparsely-populated countries like Ireland, where either labor is difficult to obtain, or the repairs have to be carried out some distance from a center of population. The wagon containing the installation can be rapidly conveyed to the spot, and the air compressor can be set in working order *en route*, so that it is possible to commence operations directly the structure in need of repair is reached.

RECENT OBSERVATIONS OF THE PLANET MERCURY.

BY EMILE GUARINI.

M. L. Rudaux, director of the private observatory of Donville, France, has devoted himself for ten years to the study of the planet Mercury, and, owing to the favorable situation of his observatory, has had an opportunity of making upon this planet a series of observations from which conclusions not lacking in interest have been drawn.

The planet Mercury was the last discovered by the ancients because, on account of the nearness to the sun, its brightness is lost in the dim light of dawn and dusk. Even with modern instruments it is difficult to observe. Its elongation of small amplitude; its location on the horizon or thereabout (always less clear than the high regions of the sky) at the most favorable instant for observations, and the great rapidity of its proper motion are all obstacles to be considered. Scientists are not even agreed as to the period of revolution of Mercury. Schiaparelli found that the planet rotates on its axis slowly in a time equal to that of its revolution around the sun and always presents the same face to the sun. Denning claims to have seen spots which have shifted in position upon it. Ever since the observations of these two astronomers a dispute has existed, certain astronomers having verified the displacement of the spots, and others not having observed it. Every contribution to the study of Mercury is therefore of importance, and from this point of view the observations of M. Rudaux, extending over a period of ten years (1892-1903), are most valuable.

In the first place, M. Rudaux has found that the phase observed is always less than the phase calculated, and in proportions which vary, but which are at times very notable. The majority of the observations have been made at the time of the eastern or evening elongations, and each time the phase has been found already in crescent, while the planet was reaching elongation and should have presented the aspect of a perfect half-disk. The apparent dichotomy therefore manifests itself before the epoch at which it ought theoretically to take place. The mean of such advance is from three to four days, but this figure appears to vary from two to five days. With the elongations of the morning the same phenomenon is observed, in inverse direction, the dichotomy manifesting itself with a retardation that appears to be of the same order as the advance for the eastern digressions.

Aside from these anomalies of the line of the phase or the terminator of the phase, M. Rudaux has noted that, very often, this terminator, instead of appearing in the geometrical form that should result from the illumination of a regular globe, presents deviations and distortions that indicate changes of level in the illuminated surface. Often also the southern horn appears truncated. As a general rule, these changes of level correspond to the various configurations of the disk. The projections seem to be caused by the illuminated regions, the depressions exhibiting themselves especially when the dark spots partially occupy the terminator.

The dark spots are very apparent, even more apparent than those of Mars. Sometimes they are almost black. It is difficult to observe them, however, because of the small size of the disk and of the rather poor quality of the images, which prevent their details from being made out and the limits of their contours from being fixed. As to general form, some appear roundish and others like wide bands connecting the first. Their color is gray, while the rest of the planet is of a yellowish or orange shade. The edge of the disk, the limb, is white and very luminous. The general luminosity of the planet decreases very rapidly from the edges toward the center, which is sometimes very dark.

M. Rudaux has, in addition, observed some light spots more or less white, and of which the accompanying figures show good specimens. They seem to be of two kinds, one of them sometimes very vague and apparently connected with certain configurations of the disk, and the other very white and often sharply defined under the form of caps and occupying pretty exactly the horns of the phase. All do not appear to have the same fixedness as the dark spots and seem to be due to phenomena of a rather temporary order.

One of our figures explains diagrammatically the anomalies of the phase. It must be taken, of course, for what it is worth, that is to say, a very plausible explanation of certain phenomena produced by Mercury. Like all diagrammatic figures, it is necessarily somewhat exaggerated in its details. But such as it is it remarkably reproduces what is required of it. In order to judge of it well, it must be looked at from a distance, say of 30 feet or more, or, better still, be observed in a camera with a slightly insufficient focusing. This will very well reproduce the aspect of the small telescopic image much influenced by atmospheric disturbances, those famous disturbances that make astronomers despair. What, now, are the conclusions that M. Rudaux draws from his observations?

Let us take up each point in succession. Let us recall in the first place the anomaly that makes the visible part of the planet appear smaller than that which ought to result from its position and from its illumination by the sun. It seems that it is necessary to seek the cause of it in the nature of the matter of the planet. M. Rudaux sees therein an analogy with the moon. But Mercury, in consequence of the difficulty of observation, cannot show the thousand luminous and dark details that we see in our satellite, and the final result is a great loss of light, which destroys the true limit of illumination, so that the eye cannot succeed in penetrating the illuminated features that should be delineated therein. In the center, the aspect is more pronounced than toward the horns at the edge, where all the details show themselves more and more contracted in perspective one before another, the low parts appearing situated in the shade. The result is that the horns have a total brilliancy greater than that of the center.

The explanation given for the horns may likewise explain the great luminosity of the limb. Nevertheless, M. Rudaux, in showing this analogy with the moon, thinks that it is very certain that it is necessary to add the atmospheric phenomena thereto in order to exaggerate these aspects. In fact, the presence of an atmospheric stratum absorbing the solar rays, especially those which, tangent to the globe, traverse it at the greatest thickness, results in the limit of illumination being reduced by such absorption. Since such influence is exerted with a greater or less intensity according to the atmospheric conditions, certain variations observed by M. Rudaux would be explained, at the same time as the illumination of the disk upon its edges, by a greater and greater superposition of the illuminated strata. Upon the whole, the observer concludes that the surface of Mercury is quite broken and presents changes of level and eminences of a mean altitude of from 9,840 to 13,000 feet, very approximately. There are also some that are higher, especially in the southern hemisphere.

As for the nature of the dark spots, it would be difficult to give an exact definition of them. It is certain, however, that they appear to have some analogy with those of the moon. What is evident is that they really belong to the matter of the planet, without apparent variations in aspect. And what of the white caps that appear to occupy the poles of the planet? Could accumulations of snow and ice occur to form these white zones? For want of a better theory, it is not unreasonable to admit this and to explain the spots by the production of atmospheric condensation in these regions of high plateaux, and also by huge banks of accumulated clouds. This would explain the sometimes vague and nebulous aspect and the variability of these zones. At all events, meteorological accidents take place upon the entire planet, as is shown by the changing and hazy appearance of certain regions.

Such are the first results to which M. Rudaux has been led. They will, without any doubt, appear of interest through the new facts that they add to our knowledge of this little world of Mercury, which presents numerous problems, for the solution of which no effort should be spared.

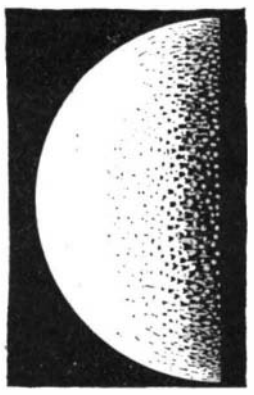
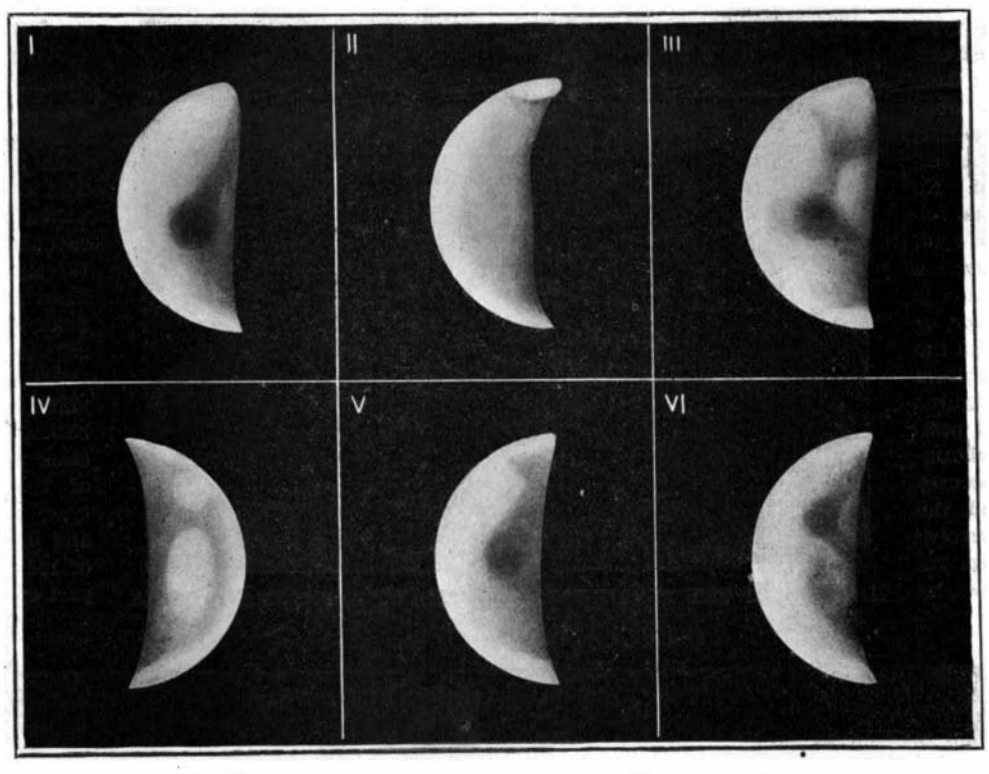


Diagram Explaining Some Anomalies in Mercury's Phases.



PHASES OF MERCURY AND THE SPOTS OBSERVED UPON THE PLANET'S SURFACE.

Dr. Cook's Return.

Dr. Frederick Cook, who unsuccessfully attempted last summer to ascend Mount McKinley, in Alaska, the highest mountain in North America, has recently returned to his home in Brooklyn.

Dr. Cook said to a representative of the New York Times that the trip had completely established the fact that it is impossible to scale Mount McKinley, 20,400 feet high, from its western side, but that three routes were noted on the eastern slope, by one of which it is possible the summit may be reached.

"Following the suggestion of Mr. Brooks of the Geological Survey," said Dr. Cook, "we determined to attack the west side of the mountain, and made our start from Cook Inlet at Tyonek. Our equipment of 2,200 pounds was carried on fifteen pack ponies from the Yackimer Indian Reservation. We followed an Indian trail to the Kuchatua River, crossing the Beluga and Skewentna rivers by boat. On the way I climbed Mount Yenlo, 4,500 feet, and obtained a good view and survey of the whole McKinley Range.

"We followed up the Kuchatua in a westerly direction, crossed the McKinley Range, through Simpson Pass, and proceeding along the northwestern slope of the McKinley Range above the timber line, we reached Mount McKinley on August 14. This left us but fourteen days in which to make our trial, the practicable season ending September 1.

"We first attacked the mountain from the southwest, but were stopped by a glacier which interrupted the route some 2,000 feet below us. In the second attempt we reached an elevation of 11,400 feet when we were stopped by a spur of the main mountain, with almost perpendicular slopes of granite rock, forming an impassable obstacle to any ascent from that side. The mountain is an almost continuous series of granite cliffs, corniced by overhanging glaciers. We were greatly hampered by the advance of winter and heavy snow, which made it necessary for 2,000 feet of the climb to dig away thirteen inches of snow before cutting the steps in the glacial ice.

"After finding the western slope entirely impracticable, we had to get out of the country quickly, and instead of returning the way we had come, we decided to cross the range and come down the east side, traveling over 100 miles of unexplored country. We found a break in the range fifty miles northeast of Mount McKinley, at an elevation of 6,000 feet, crossed it, and dropped down into the valley of the Sushitna, striking the Chulitna, the largest tributary of the Sushitna River. This flows through a remarkable cañon, which made it necessary to abandon our horses and take to rafts, on which we came down through the unexplored eastern foothills of Mount McKinley.

"We discovered two glaciers, one probably the largest in the interior of Alaska, and made a rapid survey of the east slope of the range. On September 15, two weeks later than we should have remained, we left

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Mount McKinley, and in five days had reached tide water at Cook Inlet."

The trip was one of great hardship, on the return trip especially the men's clothing being drenched constantly by frequent immersions in the glacial streams. They opened up the best hunting grounds in America for caribou, mountain sheep, and moose, Dr. Cook says, the western foothills being a great game preserve.

"Mount McKinley is of granite weighted down with not less than fifty disconnected glaciers, with everywhere precipitous walls," said Dr. Cook. "It is probably the most difficult mountain in America to ascend on account of the distance from the coast line, supplies having to be carried 400 miles through difficult country, and the Arctic conditions encountered from the start. On the east side there are three glaciers, which terminate at an altitude of about 11,000 feet and over these a route to the upper valleys of the summit may be found."

High mountains are always conspicuous, and we invariably find in descriptions of the continents and islands mention of the culminating points of those lands. The following table gives the names and heights of the twenty-four great mountains of the world which are the highest points in all the continents and in the most important islands, arranged in the order of their altitude:

Mount Everest, Asia	29,000
Aconcagua, South America	23,091
Mount McKinley, North America	20,467
Kilimanjaro, Africa	19,680
Mont Blanc, Europe	15,800
Mauna Kea, Hawaii	13,808
Kinabalu, Borneo	13,094
Mount Victoria, New Guinea	13,202
Gunung Korintji, Sumatra	12,480
Fujiyama, Japan	12,400
Mount Erebus, Victoria Land	12,365
Mount Cook, New Zealand	12,350
Pico de Teide, Canary Islands	12,234
Gunung Semeru, Java	12,037
Lompobattang, Celebes	10,069
Petermann, Greenland	9,184
Cinto, Corsica	8,888
Tsiafajavona, Madagascar	8,626
Pedrotallegalla, Ceylon	8,331
Ida, Crete	8,058
Mount Townsend, Australia	7,347
Oreafa Joekul, Iceland	6,428
Chydenius, Spitzbergen	5,576
Cradle Mount, Tasmania	5,395

DR. GRETH'S AIRSHIP.

BY ARTHUR INKERSLEY.

Dr. August Greth, an Alsatian by birth and a physician by profession, made an ascent over the city and bay of San Francisco on Sunday, October 18, in an airship of his own invention. For twenty years he has taken an interest in aeronautics, and has had nine patents for airships granted by the United States. The ascent was made from Market and Eleventh Streets, San Francisco. The airship sailed over the westerly part of the city, sometimes at a height of 2,000 feet, and at times at half that altitude. When it reached 2,000 feet, the motor was started, and the airship responded by descending several hundred feet and moving in a semicircle, first to the north and then to the south. While passing over the Presidio reservation, the craft first ascended quickly and then began to descend. At last it fell into the bay, on the surface of which it floated, the navigator swinging from his car into the rigging. Dr. Greth and the balloon were picked up and towed to the shore by a crew from the life-saving station of the Presidio reservation. The doctor was wet only up to the waist, and explained that he could easily have crossed Golden Gate and made a landing in Marin County, or have gone over to Alameda County and descended there, but that the expense of bringing back the airship from either of these counties would have been much greater. So he purposely descended in the bay.

Dr. Greth said that the balloon was entirely under his control for the greater part of the time that he was in the air, and would have been completely so except for certain defects in the motor and the balloon. The motor is a gasoline one, nominally of 10 horse power, but really developing only 6 horse power, and weighing 500 pounds. The balloon is not provided with automatic expansion-valves such as are fitted to the airships of Santos-Dumont. At 2,000 feet the motor failed, and the gas in the envelope under the hot sun, expanded rapidly. Not being able to descend by the aid of the motor, Dr. Greth was obliged to let some gas escape from the balloon, which was so tense from the expanded gas that there was danger that it might burst. After letting out a quantity of gas, Dr. Greth tried to get the motor to work again, but was not able to do so.

The inventor and his associates are not men of means, and are handicapped by the lack of funds to equip the airship properly. Dr. Greth says that a motor suitable for his purpose will cost $1,000, and that, when he has it, he will sail the airship at will at a speed of thirty miles an hour in calm air. When the wind is favorable, its velocity will be added to the rate at which the airship will travel.

The inventor has had to be content with two propellers, but his intention is to have four, two at each end of the frame. The propellers are to work separately or together, and at any desired angle, so that the ship can be turned in any direction, even against a strong wind. The propellers are all to be run by one motor in the body of the car. Dr. Greth believes that the only practicable airship is one that is supported by a gas lighter than air. He is satisfied that a dirigible airship buoyed up by a balloon is practicable, and says that his own craft, if properly equipped, will go through the air under all conditions of weather at a high rate of speed and will be perfectly under control.

Dr. Greth's airship consists of a balloon, which, when inflated, has a length of 75 feet and a maximum diameter of 25 feet. From the balloon is suspended a frame, which supports the motor and the platform for the navigator. Dr. Greth has done away with the balloonette used by Santos-Dumont and Stanley Spencer, which nitrates the hydrogen gas by mixing air with it. Dr. Greth has a netting over his balloon, which keeps it taut on the top and at the ends, preventing it from buckling. The frame is only seven feet below the balloon, thus rendering the ship more dirigible. By proper manipulation of the four propellers, the balloon can be kept always in a horizontal position, can be raised or lowered, and driven in any direction at will. All that the inventor wants is a powerful enough motor of light weight, and then he will demonstrate the practicability of his theory of navigating the air. He hopes that the partial success of his machine, poorly equipped as it is, will prove the means of supplying him with the funds necessary to equip his airship properly. His machine is more buoyant and more dirigible than those which have the frame swung at a distance of twenty feet below the balloon.

The Current Supplement.

The current SUPPLEMENT, No. 1453, opens with a most striking picture of a peak in England's mountainous region, a peak which may be ascended only at great risk to life and limb. An article on the operation of gas ranges gives a vast amount of practical information that will surely be found of value. McLennan and Burton present the results of some experiments on the electrical conductivity of air. Mr. Emile Guarini describes the De Mare electro-thermic fan. "The Light Aluminium Alloys" is the title of a very instructive paper read by Dr. Joseph W. Richards before the American Society for Testing Materials. Prof. Léonce Fabre tells much that is of value in an article on the treatment of finely divided ores. "How Woven Hose is Made" is a subject which is discussed by Mr. Day Allen Willey. The paper on Geography read by Capt. Ettrick W. Creak before the British Association for the Advancement of Science is presented in full. Miss Mary Proctor describes the proposed Amherst College Observatory in full. A horological curiosity in the way of a one-wheel watch is also described.

Failure of the Second Ziegler Expedition.

Dispatches from Europe state that the second Ziegler North Pole expedition has failed to reach Franz Josef Land. Mr. Ziegler does not credit the report. A letter was received not so very long ago from Mr. Fiala, who stated that it was probable that his ship would reach Franz Josef Land and winter there. Otherwise it would have been necessary to return to Norway before this. The ship had not coal enough to keep under steam all this time. Had she failed, Mr. Ziegler believes he would certainly have heard from Mr. Fiala by this time.

Extermination of the Clam.

The clam seems to be sharing the fate of the lobster. It is fast disappearing—so fast, indeed, that the United States Fish Commission is endeavoring to propagate the mollusk by artificial culture. The Fish Commission has confined its attention to the soft or long clam. The State of New York, on the other hand, is studying the round or hard clam. Both researches seem promising from the results thus far obtained.

The total power generated and used by the St. Louis Exhibition will be in the neighborhood of 50,000 horse power. Over 80 per cent of the electric energy will be in 6,600-volt, three-phase, 25-cycle current. The largest unit will be an 8,000-horsepower steam turbine, and the next largest a 5,000-horsepower compound horizontal and vertical reciprocating steam engine. The largest steam engine in the Paris Exposition of 1900 was rated at 4,000 horse power.

General Programme of Competitive Trials of Subsurface and Submarine Torpedo Boats.

The following rules have been drawn up for governing the competitive tests of the new Holland boat "Fulton" and the Lake boat "Protector." The trials are to be held at Newport, R. I., November 16.

Each boat must be provided with a small mast whose top is 25 feet above the water line of the vessel when she is afloat, and 5 feet above any of the other pipes or apparatus projecting above the deck. The mast of the "Protector" will be painted with alternate bands of black and white, and that of the "Fulton" with alternate bands of red and yellow, and on top of each mast will be mounted a small sheet of metal which will act as a pennant and be painted a distinguishing color. By means of the mast and pennant, it will be possible to at all times know the exact position of the competing boats, even when they are submerged.

The tests will be of such a character as to determine the following points:

1. The maximum speed at which the boat can be operated under the conditions of service for which it was designed. Speed trials will be made in (*a*) the light condition, the vessel having all ballast tanks empty and being propelled by its gasoline engines; (*b*) in the awash condition, in which the boat is ready for instant diving and propelled by its electric motors, a dive being made at the end of the measured mile; and (*c*) in the submerged condition at a sufficient depth for not more than 3 feet of the mast to project above the surface.

2. The maneuvering powers of each boat under various conditions of operation for which the maximum speeds as described above are determined, will be noted during the different trials, and special tests may be made to demonstrate further the character of the qualities possessed by each vessel. These tests will include those necessary to show the ability of the vessel to remain in any position and to reverse her direction of motion when submerged, i. e., when going ahead submerged, to stop and go astern with as slight changes as practicable in her trim and depth of submersion.

3. The ability of each vessel to maintain steadiness of route in both the horizontal and vertical directions, when navigated in either the awash or submerged conditions, will be noted during the various trials and extra tests may be made to further demonstrate the character of these qualities possessed by each vessel.

4. The times to pass from the light condition to the awash condition, and to dive from the awash condition to certain prescribed depths, will be noted during the various trials.

5. Trials will be made to show the times required by each vessel to discharge the full number of torpedoes carried, and to fully demonstrate the ability of the vessel to perform with efficiency all functions connected with her torpedo outfit.

Torpedoes will be fired while the vessel is on the surface and also when totally submerged. The firing trials will be made either as separate tests or as part of the service trials.

6. Trials will be made to show the radius of action when running totally submerged.

7. Trials to demonstrate the habitability of the vessel by requiring the entire crew to remain on board 24 hours, during which time the vessel shall be self-sustaining. An air supply for 12 hours for full crew and two additional persons must be carried.

8. Service trials approximating in the closest possible manner the probable and reasonable requirements of submarine warfare will be held. They will fulfill the following conditions:

(*a*) Service test of submarine operating from a shore base against a vessel in the open sea, by the boats going in light condition out to a stake vessel, submerging, approaching a second stake vessel, and discharging torpedoes between two cutters 300 feet apart. Two target spaces will be provided, so that both boats can fire at the same time. The use of periscopes or other sighting apparatus is permitted, but account will be taken of the time such instruments are visible, the least possible surface disturbance being the desideratum.

(*b*) A second similar test will be made for demonstrating the conditions of operation when the periscope is not used.

(*c*) A test with the boats starting from open sea, approaching and entering the harbor in a submerged condition, and cutting and removing a length of cable such as is used for harbor mines. The time required will receive consideration, and vessels must be navigated at the highest speed possible under the circumstances.

Marconi Receives a Nobel Prize.

The Academy of Sciences, which awards the Nobel prize, has decided that the recipients for this year shall be as follows: Literature, Henrik Ibsen and Bjornstjerne Bjornson; physics, Signor Marconi; and medicine, Dr. Finsen.

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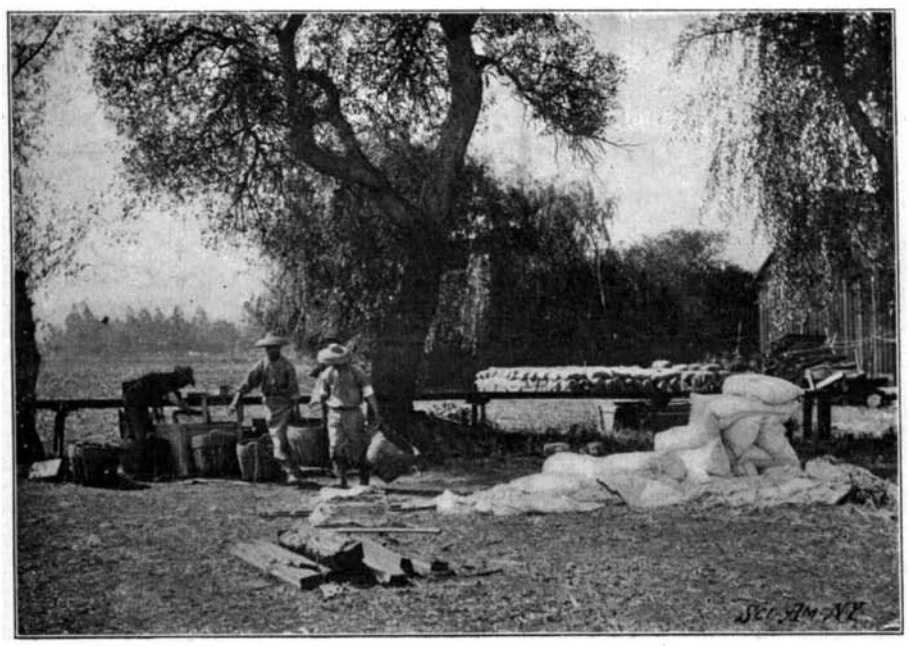
A CALIFORNIA ONION-SEED FARM.

As the means of transportation are improved throughout the country, the tendency is for each region to confine itself more and more to the production of those crops for which its natural qualities and conditions best fit it. Thus, California and Oregon supply a large proportion of the hops used in the United States; nearly all the prunes consumed in the whole country are yielded by Californian orchards; vast quantities of raisins, apricots, peaches, oranges, and other fruits are sent from Southern California to

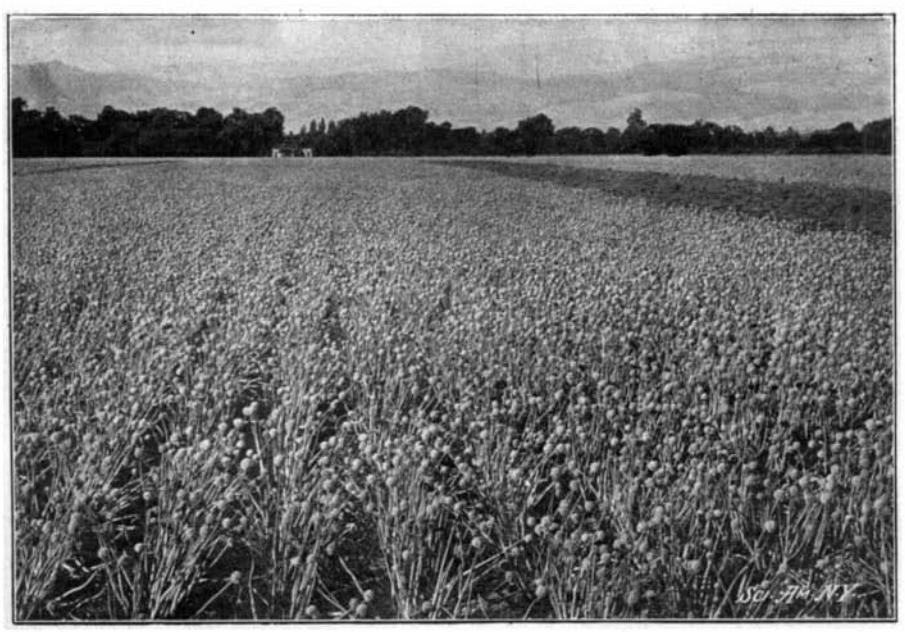
Spreading the Onion Seed to Dry.

Threshing Onion Seed in Santa Clara, Cal.



Washing the Onion Seed.

Fanning the Onion Seed.



An Onion-Seed Farm in Santa Clara Valley.

View of a California Onion Ranch, Showing Irrigation Trenches.

A CALIFORNIA ONION-SEED FARM.

are no scorching heats and no biting frosts; rain usually falls in ample quantity to mature the seed while it is growing; and dry weather, with some wind, may almost always be counted on at the harvest season.

Seeds grown in California, being dried entirely by the agency of pure air and genial sunshine, are of higher quality than those produced in climates where artificial heat must be employed. They are more vigorous and germinate more readily. In Santa Clara Valley three thousand acres of land are given up wholly to the cultivation of seeds. During the

various parts of the world. On the islands in the Sacramento River asparagus is grown in great abundance, and from the peat-lands of Orange County, California, hundreds of carloads of celery are sent away each year to the Eastern States. The best maple syrup comes from Vermont, and a man in Texas raises the finest pecan nuts.

The Santa Clara Valley to the south of San Francisco is eminently adapted to the production of flower and vegetable seeds, on account of the high fertility of its soil and the regularity of its seasons. There

season of 1901 these seed farms yielded 1,035,000 pounds of seeds of vegetables and flowers, all of which went to the wholesale dealers and were made up by them into small packets to be sold at retail grocery stores throughout the land.

Of the more than one million pounds of seed grown in the Santa Clara Valley, about half is onion seed. This is planted in November and December, the operation being but little interfered with by rain. On an onion farm weeds must be carefully eradicated, in order that the seed may be preserved in its purity. There are many various kinds of onions, and their seeds are kept separate and distinct, so that the purchaser may be able to rely on getting the variety he desires.

The White Portugal is a mild onion and fetches the highest price in the market, because it yields fewer pounds of seed to the acre than other varieties. The Australian Brown has a reddish-yellow color, and was introduced from the country whose name it bears. The Yellow Globe Danver has a bright yellow color and ripens early. The Prize-taker is large and yellow, with a mild flavor, and is said to be the best onion in the United States. The Southport Red Globe has a purplish red color. There are also the Yellow Danver, the Yellow Dutch, the Yellow Strasburg, and many other varieties.

The seed farms are kept in a high state of cultivation almost up to harvest time, which begins in July and continues through August into September. Most of the laborers employed on the onion-seed farms are Chinese. As soon as the seed is ripe, the gatherers go out into the fields, cut off the tops of the onions with

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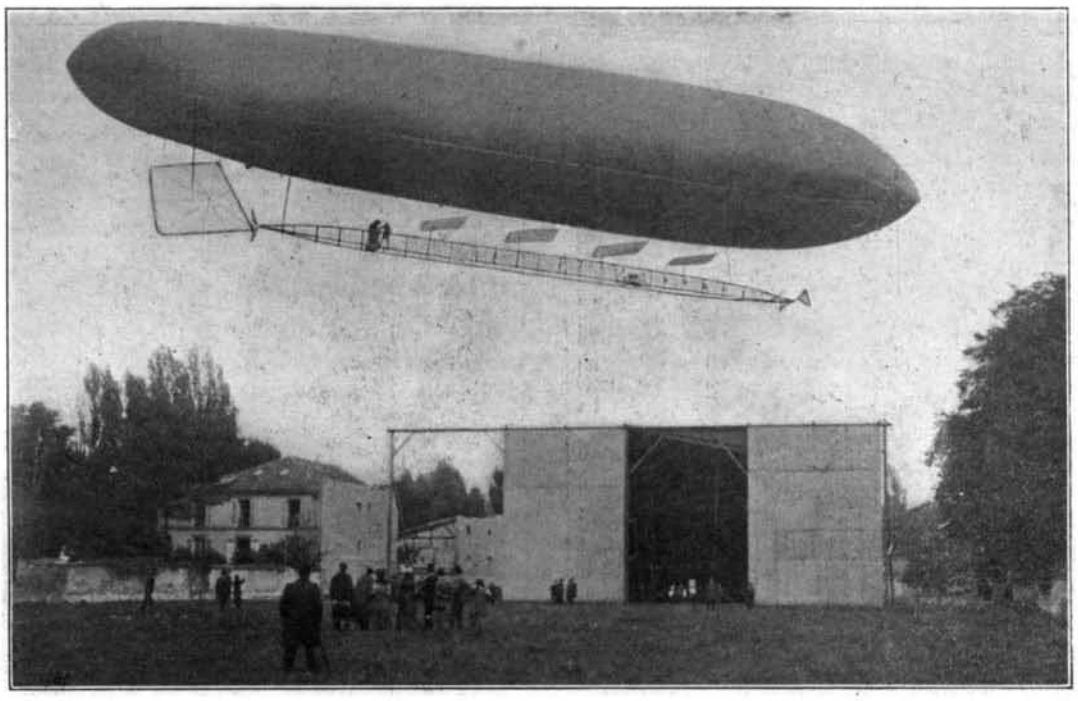
about an inch of stalk, and drop them into large baskets. The onion seeds are green when gathered, and, if cut in the morning, when the dew is still on them, take a longer time to dry than if gathered in the afternoon. The pods are conveyed in sacks in a wagon to the drying-ground, where they are spread out on large sheets to dry. Daily the heaps are turned over with a wooden fork, so as to facilitate the process of drying, which occupies two weeks or thereabout. As rain scarcely ever falls during the drying season, and the sun shines almost continuously during the hours of daylight, the operation progresses rapidly.

When the pods are thoroughly dried, they are conveyed to the threshing-machine, in which a wheel making six hundred revolutions a minute winnows the seed from the chaff. The seed is carried into large sacks, while the chaff goes into the air in a cloud, which whitens every body and everything within reach. Next it is washed in a trough to remove dirt and imperfectly developed seeds, which latter float on the surface of the water and are skimmed off. After the washing the seeds are again spread out to dry, and in four or five days are raked up and passed through a fan mill. Then they are put into sacks, each containing one hundred pounds, in which shape the commodity is marketed. The harvest being over, the stubble is burned and the ground plowed in readiness for planting the next crop after the early rains.

THE NEW SANTOS-DUMONT AIRSHIP.

With the lamentable failure of Prof. Langley's aerodrome and the accident which befell Dr. Greth still fresh in the public mind, one cannot help but admire the courage which Santos-Dumont has displayed in navigating the ten airships which he has thus far constructed. Severo and De Bradsky, in machines that differed not radically from his, both lost their lives. Still, he persists in adhering to his design with a pertinacity that shows he has the courage of his convictions. With the new airships, numbers 9 and 10, he has kept himself pretty much in the public eye of late by various theatrical exploits. He sails in to town for breakfast in an airship; he picks up children in some public park, takes them for a sail, and brings them back safe and sound; more recently the United States Minister to Portugal had the doubtful pleasure of accompanying him upon an airship jaunt.

The latest balloon, the No. 10, with which he has done some of these wonderful things, in some respects marks a departure from his previous designs. The car is about 100 feet long. Its carrying capacity is said to be ten persons. Its voluminous gas bag can contain 1,650 cubic yards of hydrogen. Its form is that of an elongated ellipsoid, measuring 159 feet, with a maximum width of 23 feet. The two ends are pointed. The envelop of the balloon, with its 850 square yards of surface, is divided into three compartments, each having a volume of 550 cubic yards. At about the center of the balloon are two interior air bags of unequal size, which communicate with each other by means of a canvas sleeve. A Clement petrol motor of 60 horse power drives two propellers of 12 feet diameter, both having the same screw pitch. In all, five baskets are to be distributed along the car-frame. Since the tendency to pitch will be thereby increased, two pairs of horizontal planes are placed to the forward and rear of the center of the framework, which are arranged along the axis, for the purpose of keeping the craft in proper longitudinal trim. The planes measure 6 x 6 feet, and have in all 144 square feet of resistant surface. They are movable, and are controlled by a set of levers.



THE SANTOS-DUMONT NO. 10, ON ITS FIRST ASCENT, OCTOBER 19.

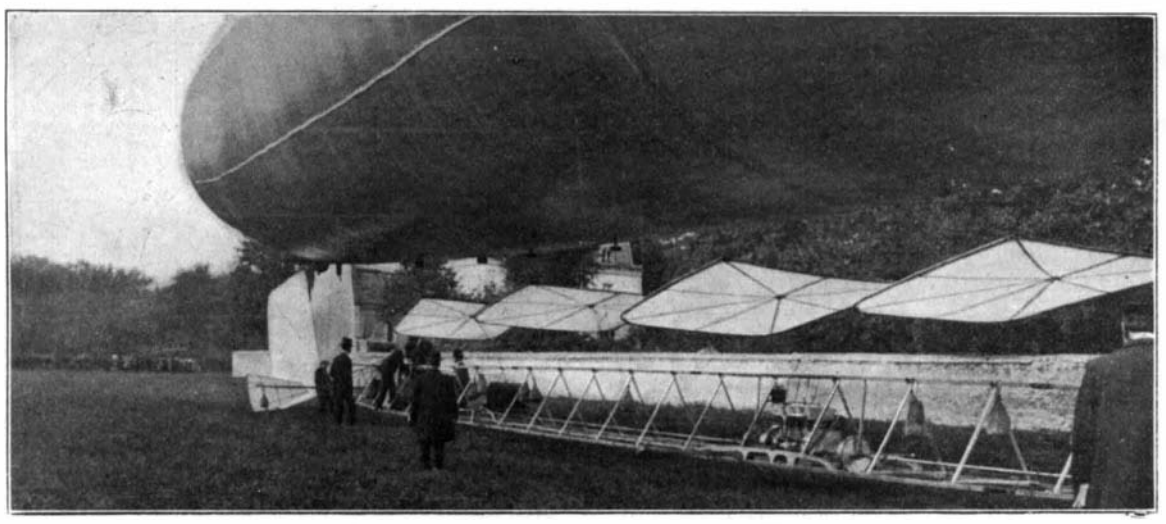
Five baskets in all will be used, the total carrying capacity being 10 passengers.

Wireless communication has been established between Japan and Formosa.

Important Step in Electric Traction.

A practical experiment of the highest importance and interest in the development of electrical railway service is now in progress on a suburban line between Niederschönweide and Spindlersfelde, in the southeastern quarter of Berlin.

During the past week there has been in daily operation a car driven by a new motor invented by a young Austrian electrician and built from his plans by the Union Electric Company, of Berlin. This motor achieves with apparently entire success what has not been accomplished hitherto—at least not in Europe; it propels the full-sized service car at any desirable degree of speed without employing any cumbrous and expensive regulating devices, while deriving its energy from a single-phase alternating current of 6,000 volts, carried along the line on one small trolley wire and delivered directly to the motor without conversion to a lower voltage or a continuous current.



A VIEW OF THE AIRSHIP, SHOWING ITS MOTOR AND PLANES.

The far-reaching importance of this demonstration—which will be at once recognized by every electrical engineer—will be apparent when it is remembered that electric traction, which has proven so effective and economical for interurban and suburban service, has met hitherto some very serious economic difficulties when applied to long distances. The method heretofore employed has been to send over the line alternating currents of high pressure which are taken off at intervals by substations equipped with step-down converters that reduce it to a continuous current of low voltage, which is fed into the trolley wire or third rail and thus transmitted to the motors of passing trains.

As already noted, this works very well for short lines such as are required in city and suburban transit and which are thronged with constant traffic. But when the proposition is to extend the same practice to a standard railway, connecting two cities from 100 to 300 miles apart, the cost of the installation and working expenses become practically prohibitive. Besides the frequent substations equipped with transformers capable of converting the high-voltage alternating current into a low-pressure continuous one, there is the question of heavy copper conductors throughout the line, and this, added to the fact that the transformers and rotary converters must stand idle except when the converted current is taken off and used by some passing train, has hitherto rendered the proposition economically untenable.

When the high-speed experiments were tried last year on the government railway line between Marienfelde and Zossen, an alternating three-phase current of 10,000 to 12,000 volts was carried along the line on three copper wires and conducted thence by trolleys to transformers carried under the floor of the car, whence it was transformed to 1,150 to 1,800 volts and passed into the three-phase induction motors. The car, as will be remembered, easily attained a speed of 140 to 150 kilometers an hour, at which pace the rails began to give way. The further experiments had to be postponed until a more solid and substantial track could be provided.

The present experiment has therefore a wholly different purpose. It involves no question of extreme high speed, but rather the transmission of a single-phase alternating current at a voltage (6,000 volts in this case) sufficient to carry it over a long line on a small and relatively inexpensive wire, and the direct use of the current, without transformation, by a motor capable of running economically at any desirable speed and which fulfills all the other requirements of electric traction. The point demonstrated by the tests now in progress is the effectiveness of the new motor for the special purpose to which it is applied. No sparking or other technical difficulty appears thus far to shadow the success of the experiments. The system eliminates the expensive substations, with their heavy initial outlay and operating expenses, and is so simple and direct in its working that it may, at least in theory, be applied to lines several hundred miles in length. If the distances are very great, of course the power may be transmitted from a distant waterfall or steam plant at any desired pressure—say, 20,000 or 50,000 volts—and then reduced in ordinary transformers, requiring no especial care, to the working-line voltage of, say, 6,000 or more. The present tests are over a line of 3 or 4 miles in extent, the length being immaterial. There may be encountered new technical difficulties when this distance is increased to as many hundred miles, but such difficulties are only such as may be met in any long-distance transmission and such as electrical science at its present stage is fully prepared to overcome. The new motor is believed to have bridged the chasm and opened the way to economical, and therefore practical, long-distance electric traction on railways of standard capacity.

Other Things Besides Radium.

S. W., in Nature, asks the following question: When a small magnet in my drawer has been ready to act on a compass any time during the last twenty years, and has not altered its appearance in any appreciable way, I ask, whence comes the continuous magnetic supply? Again, when a lady has had for a great many years a cedar workbox, which has never failed of its characteristic odor, it is a natural question to ask, whence comes the smell? The statement in books, both of physics and physiology, is that something material is given off from the wood which alights on the olfactory membrane of the nose. This is purely gratuitous, as the statement is without a shadow of proof, the box being to all appearances in no way diminished in size or otherwise altered. If the hypothesis, for it is nothing more, fails, how does the case differ in principle from that of radium?

In Germany it is intended to make the restored Saalsburg in the Rhine country a museum for antiquities from the Roman occupation and earlier times. To decorate the museum various statues of Roman emperors are in preparation. The sculptor Goetz, of Berlin, has completed his models of Adrian and Alexander Severus and submitted them to the German Emperor.

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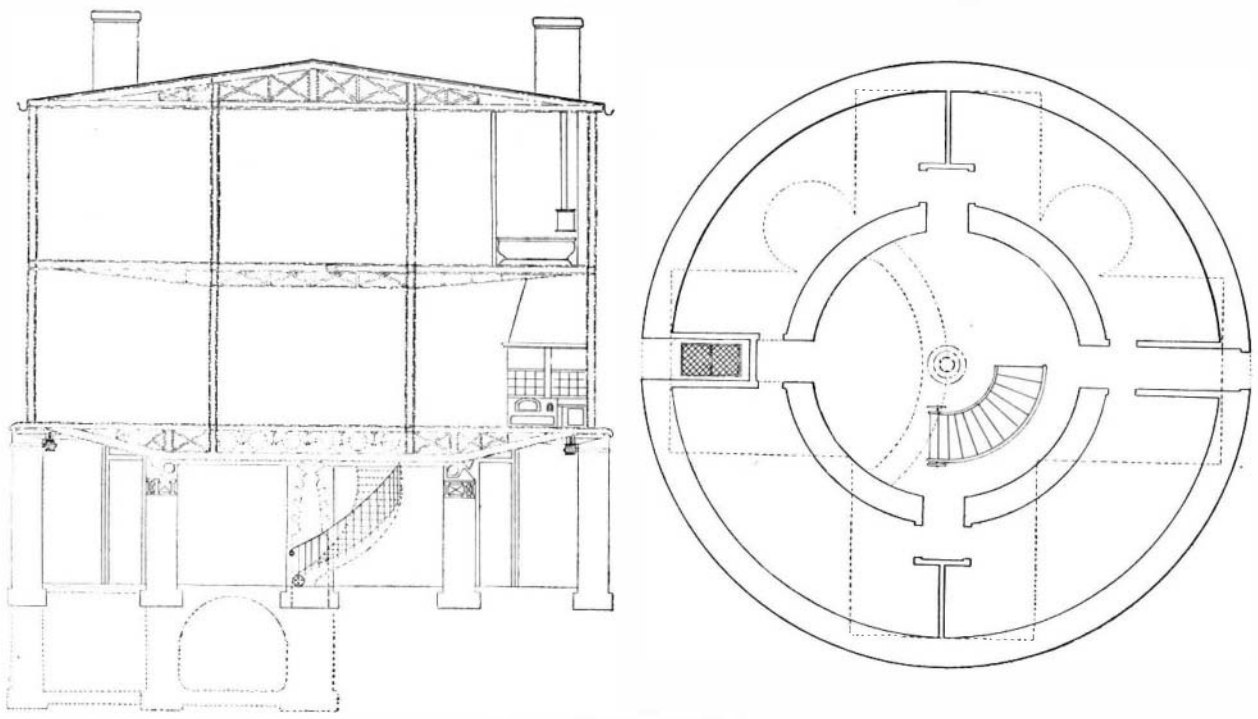
A HOUSE THAT TURNS WITH THE SUN.

One of the curiosities of the Exposition de l'Habitation, recently opened in Paris, is a revolving house, designed by Dr. Pellegrin and M. Pettit, a well-known Parisian architect.

The structure is in truth a heliotropic house, since it does just what heliotropic plants do. In other words, it always presents the same facade to the sun, from dawn until dusk. Probably to most of the visitors to the Exposition the house was regarded as an architectural curiosity, with no practical value whatever. As a matter of fact, it was designed to meet certain scientific requirements in applying the doctrines of heliotherapy, of which we have heard so much through the work of Dr. Finsen.

It has been proven clearly enough not only that a healthy dwelling should be well ventilated, but that it is quite as important to have it well lighted. Sunlight is a potent bactericide. Most houses, indeed, even the most carefully designed structures receive but a very small portion of the sun's rays during the day. This new and curious structure of Dr. Pellegrin's is intended to obviate this defect, and to provide a kind of family sanatorium. For that reason it has been planned so that it will receive the largest possible quantity of sunlight during the day. The walls are hollow and are entirely insulated from heat and from cold, so that the house will be neither too warm in summer nor too cold in winter.



Plans of the Revolving House.

The mechanical features of this peculiar building are not without interest. The mechanism by which the structure is turned consists of a vertical shaft, which is driven by machinery located in the basement. The house itself rests upon a platform or turntable flush with the ground, leaving the basement free, so that it can be used as a cellar.

Under these conditions the ball bearings, on which the turntable rests, have a receiver of considerable diameter, and arranged on a suitable metallic crown supported by a massive annular masonry wall within which a staircase is built, fixed to the turning structure and carrying rollers at its lower end which rest on the floor of the basement and enable the staircase to turn with the house. Doorways in the annular wall permit access to the various rooms. In the middle of this basement an arrangement is mounted on two parallel masonry supports, which consists essentially of a cone on which two-part rings turn, their number being such as to prevent their axial displacement. These rings are provided with an interior coiled spring which is frictionally seated in an annular recess.

The rotation is obtained by means of a pinion which is geared to a circular set of teeth fixed on the platform. A central apparatus, above which the house turns, allows the introduction of water, of gas, of electricity, as well as the exit of water, etc.

The dwelling is turned either by hand or by means of a motor. The latter plan is necessary if the house exceeds two stories in height. If the structure be turned by hand, it is simply necessary to move a lever once an hour in order to cause the house to turn a few inches. If the house be turned by mechanical means, it must make a complete revolution in twenty-four hours, which can easily be attained by properly regulating the mechanism. The movement is so slow that the inmates hardly perceive it.

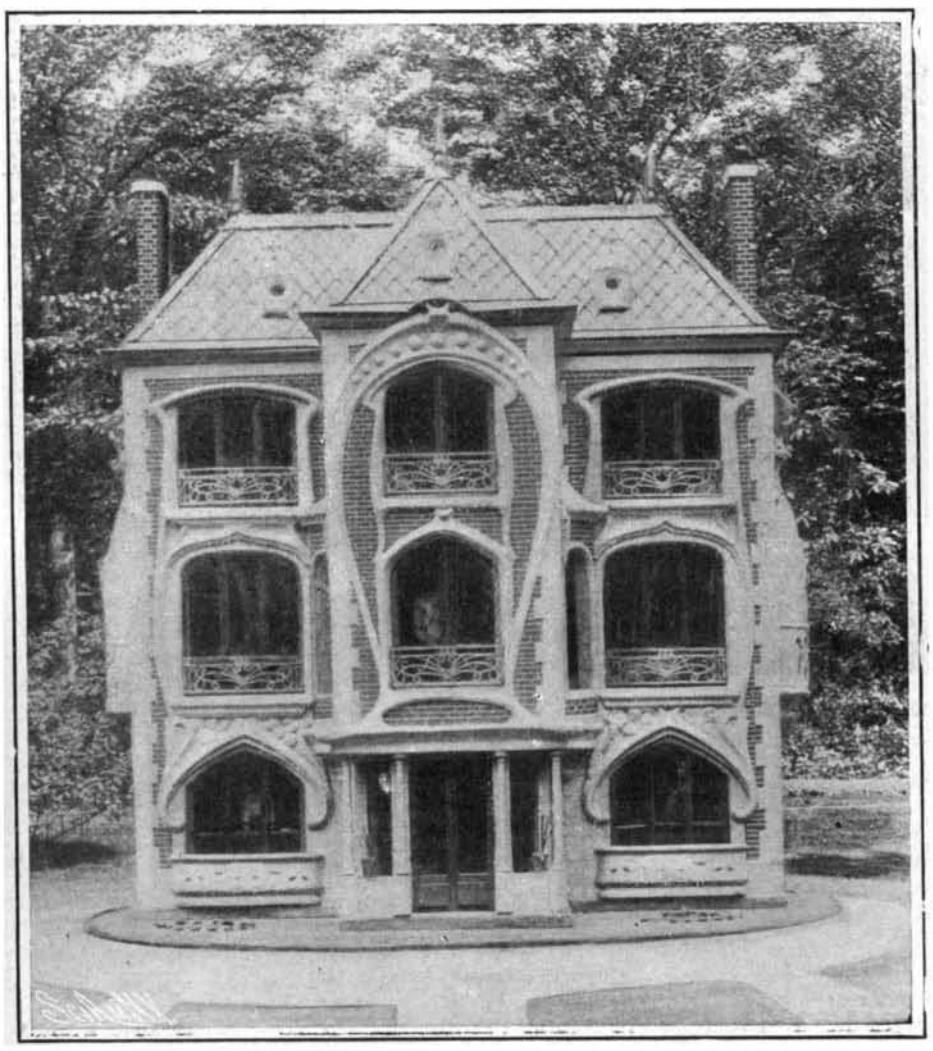
The Australian government has decided to call for tenders for the manufacture locally of sixty to a hundred locomotives.

Radium Emanations for Consumption.

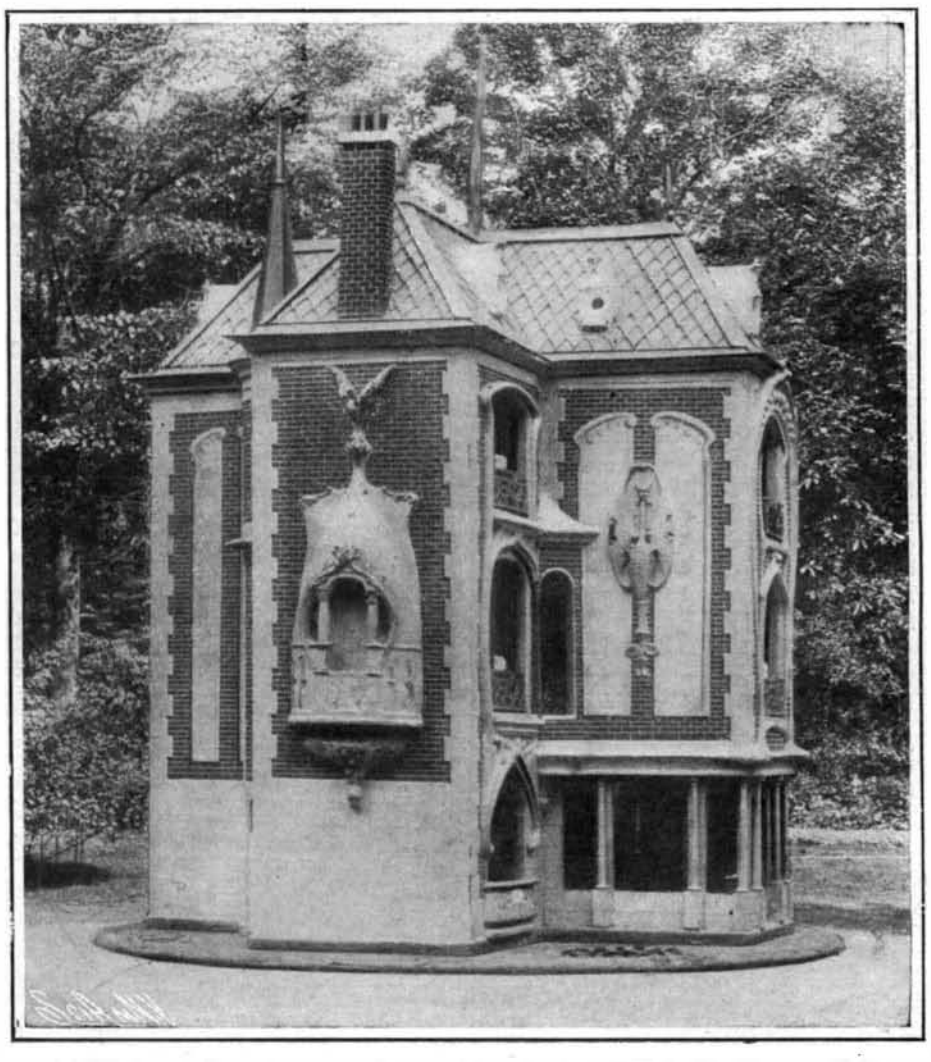
Frederick Soddy, who was Prof. Rutherford's assistant at McGill University, in Montreal, has suggested another use for radium. He argues that, as it has been found to cure consumption of the skin (lupus), it should also cure consumption of the lungs, if its rays can be brought to bear directly on the diseased lung tissue, without any intervening substance, such as the chest wall. At first sight this seems rather a difficult thing to do, as it is, of course, out of the question to place any solid mass of radium within the lungs themselves. But recent studies have shown that radium in solution gives off a gas and that this gas is itself radioactive. So all that is necessary to subject the internal lung tissue to the direct action of radium rays is to breathe a mixture of air and the radium gas. By this means Mr. Soddy believes a new and valuable remedy for consumption will be available to the pathologist. The rays from radium have already proved useful in the treatment of several forms of skin disease, and it has been suggested that the insertion of minute particles of radium in the interior of a cancer is worth trying. It should be remembered, however, that even if radium proves valuable in the treatment of pulmonary tuberculosis, its cost is so high—several hundred dollars a grain—that it could not come into general use, under present conditions.

A $25,000 Prize for a Formula.

The average price of California wines is ten cents a gallon with cooperage. Such has been the enormous production of wine within recent years, that attempts are now being made to find some other use for the grapes which grow in such profusion in California. The American Grape Acid Association, 318 Front Street, San Francisco, Cal., offers a prize of $25,000 for the best formula and the right to its use, by which grapes containing over twenty per cent saccharine, and valued at $10 per ton, may be utilized in producing tartaric acid at a price which will permit exportation without loss.



The Facade of the House Presented Toward the Sun.



Another View of the House Taken from the Same Position as the Adjacent Picture.

A HOUSE THAT TURNS WITH THE SUN.

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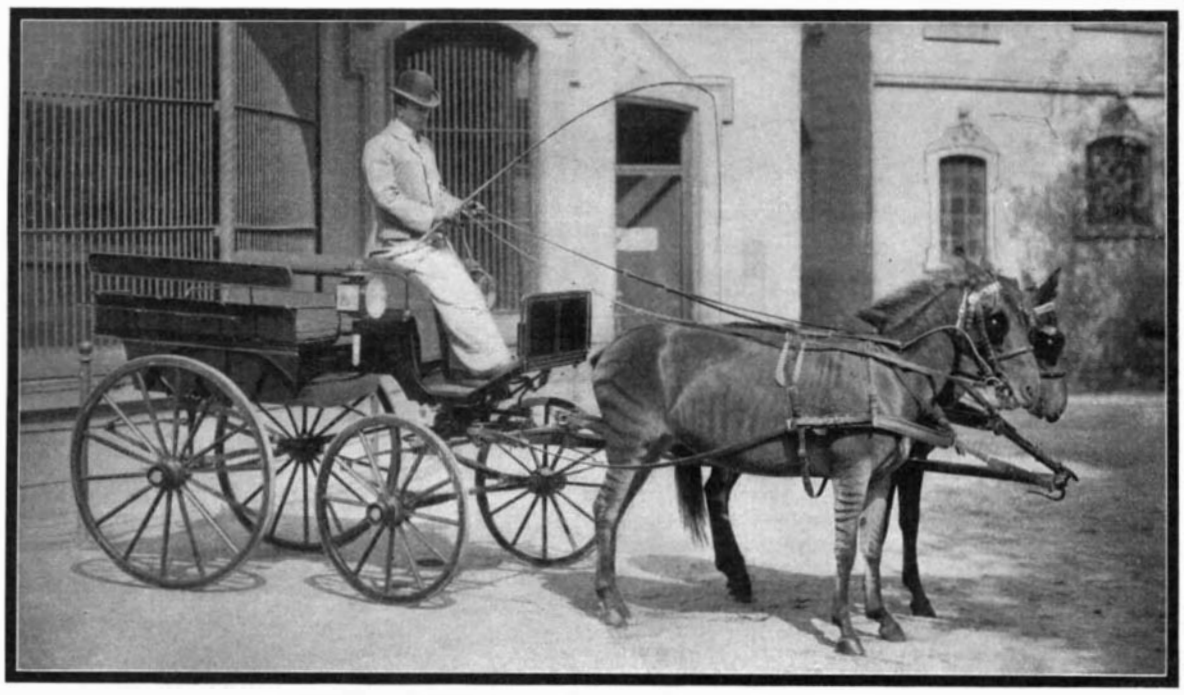
SOME NEW HYBRIDS.

BY HAROLD J. SHEPSTONE.

The recent purchase by the Indian government of two zebra-horse hybrids from Prof. J. Cossar Ewart, of Edinburgh University, Scotland, has called attention to the work of this gentleman, and, incidentally, to the experiments in cross-breeding of Mr. Carl Hagenbeck, the animal dealer at Hamburg, who has for some seven years past given serious consideration to this subject. During this comparatively short period Mr. Hagenbeck has produced an entirely new variety of sheep, deer, and pheasant by crossing the stronger, wilder species with tame, domestic specimens.

It should be stated at once, perhaps, that the one aim in conducting these experiments has been to obtain a stronger and better animal—that is to say, better blood. That this has been accomplished in the case of the zebra-horse cross there is not the slightest doubt. The new animal, which has been named the zebrule, has been produced with the object of taking up the work of the ordinary military mule. It is a little larger than the average mule, and when once broken to harness is much more tractable and far more intelligent. Furthermore, the new animal does not possess that stubborn will and dangerous tricks often found in the common mule. It is also hardy, a good trotter, very sure of its footing, and capable of adapting itself to great changes of climate and temperature.

Prof. Ewart seriously commenced his experiments nine years ago. He obtained a fine, healthy zebra stallion, "Matopo," now the sire of many zebrules. The first hybrid was born in August, 1896, at Penicuik, in Midlothian, Scotland, the dam being a pony, selected from a first-class breed, the sire, of course, being "Matopo." The foal proved strong and hardy, very easily broken to saddle and harness, while its intelligence surprised those in charge of it. The animal was produced merely for scientific purposes, but it was such a success that Prof. Ewart came to the conclusion that the new hybrid would be an ideal animal for ordnance and commissariat work.



Mr. Lawrence Hagenbeck and a Team of Zebra-Horse Hybrids.

The experiments were therefore continued, and a number of zebrules bred from thoroughbreds, half-Arabs and Clydesdales. Several of these were purchased by Carl Hagenbeck, of Hamburg. Indeed, he had already bought the two which have been dispatched to India, but willingly gave them up to the Indian government when they decided to take them, as he is convinced from his experience and handling of the zebrule that it will be the mule of the twentieth century. He is endeavoring to get the German government to take some of these animals for use in their army. He has several in his park at Stellingen, near Hamburg, and when in that city recently the writer went for a drive behind two of these interesting creatures.

Full-grown they stand about 14 hands high, and have a girth measurement of about 63 inches. They are therefore somewhat larger than a mule. At first sight they strike one as strange, the zebra striping in some instances being very distinct, though, of course, by no means so conspicuous as in the wild zebra. They answer to the reins instantly, are not at all nervous of electric cars or traffic, and fast trotters.

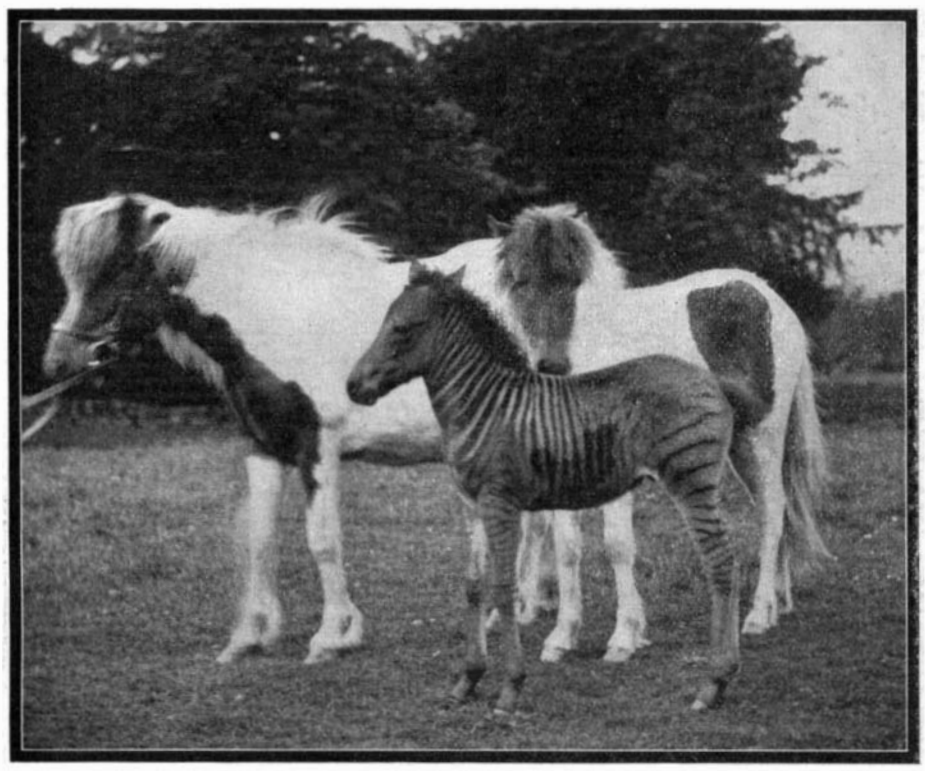
Prof. Ewart, in speaking of the hybrid in his book, "A Guide to Zebra Hybrids," says: "Zebrules are usually better able to take care of themselves than pure-bred animals, are more alert, more active, and altogether more vigorous and intelligent. From the first, zebra hybrids are more friendly, more curious and confiding than ordinary foals. With time and care most of them can be trained to any kind of work. It is almost impossible and far from safe to break in a young mule by itself, but quite possible to break in by itself a zebra hybrid."

It was hoped that the British War Office would take the new animal, but it stolidly refused to touch them. It is as well, perhaps, that the animals are to be tried first in India, where it is well known the natives manage their mules with more tact and patience than the British soldier. The animals have already arrived at their destination, Quetta, and are now undergoing a series of tests as to their suitability for mountain battery work. Although no official report has been received, it has been stated that the animals fulfill all the requirements set down by the Indian government. Indeed, so well have they behaved that a number of drives have been organized in the East Africa Protectorate for the capture of young zebra stallions for exportation to India, Jamaica, and elsewhere for breeding purposes.

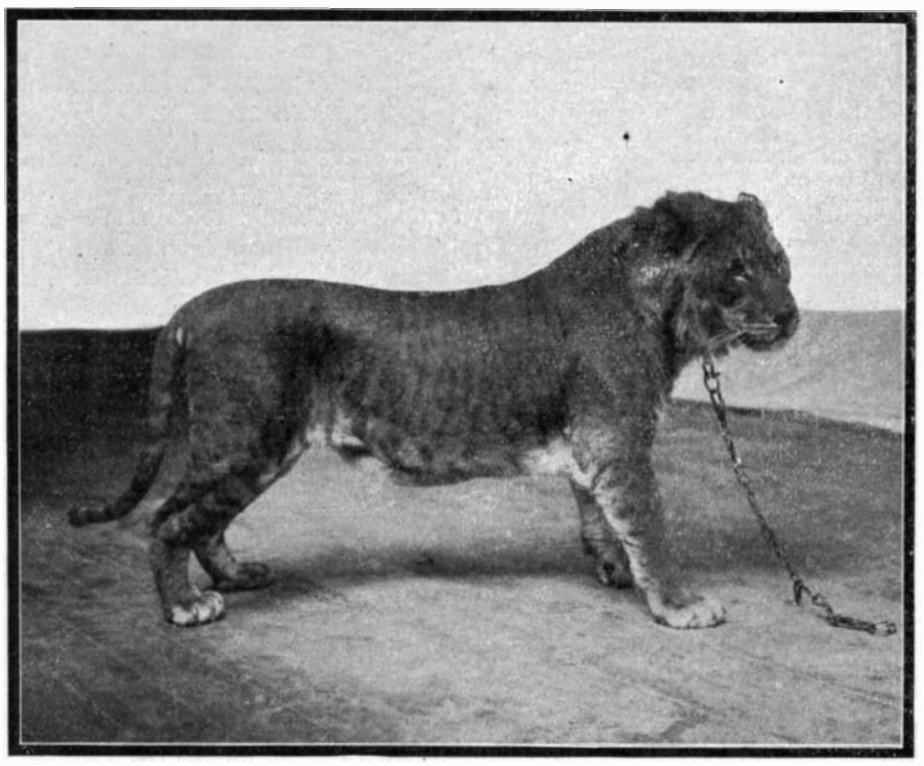
A hybrid that has attracted the attention of zoologists is the lion and tiger cross, a number of which may now be seen at the Hagenbeck establishment in Hamburg. The oldest is four years of age, and is a fine animal, called "Prince." He was recently seen performing with several other animals in one of the Hagenbeck trained groups in New York. When only three years of age he weighed five hundredweight and measured 10 feet from the tip of his tail to the tip of his nose, and stood four feet high to the top of the shoulder. The peculiarity of this beast is that he has a tiger's body and a lion's head, the stripes, of course, not being so distinct as in the common tiger. Prince's father was a Senegal lion and his mother a Bengal tiger. This one animal is valued by its owner at $10,000.

"The first successful experiment I made in the crossing of animals," said Mr. Hagenbeck, in speaking of this side of his interesting work, "was about seven years ago, when I crossed a leopard and a puma. The only living animal of the litter, which, fortunately, was a very healthy one, I sold some time ago to the Berlin Zoological Garden, where it is still in the collection. I am now busy endeavoring to obtain a new variety of sheep by crossing the giant sheep of Central Asia with our common domestic animal."

Sportsmen will be particularly interested in the new pheasant which the Hamburg establishment has produced. It has been obtained by crossing pheasants from Central Asia with the European variety. The result is a larger bird, much stronger on the wing, and more prettily marked. The new pheasant very much resembles the English or common American pheasant in appearance. It is somewhat larger, however, and sportsmen have already discovered that it is very quick on the wing, and not so easy to bring to the ground. Mr. Hagenbeck has succeeded in securing several broods of these pheasants. The first of these were obtained in April of last year. They were quickly snapped up by the Duke of Bedford and Lord Rothschild, who own extensive shooting grounds in England, these two gentlemen taking the larger portion of them. Several broods were obtained again at the beginning of this year, and the birds are all doing well. For years the European pheasant has been gradually declining, but with the introduction of the Asiatic variety it has received a new lease of life. In the same way several new varieties of deer have been secured by crossing Persian fallow deer with ordinary European deer.



Iceland Pony and Her Two Foals, the Smaller of Which is a Zebra Cross.



The Nine Months Old Progeny of a Lion and a Tiger.

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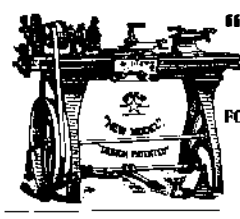

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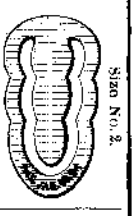

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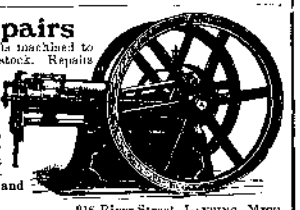

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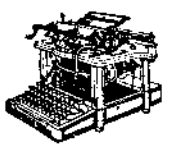

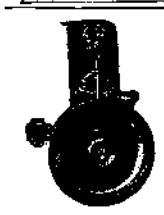

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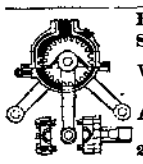

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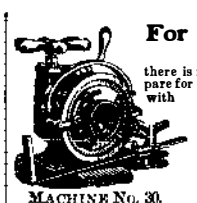

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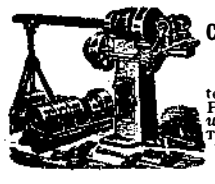

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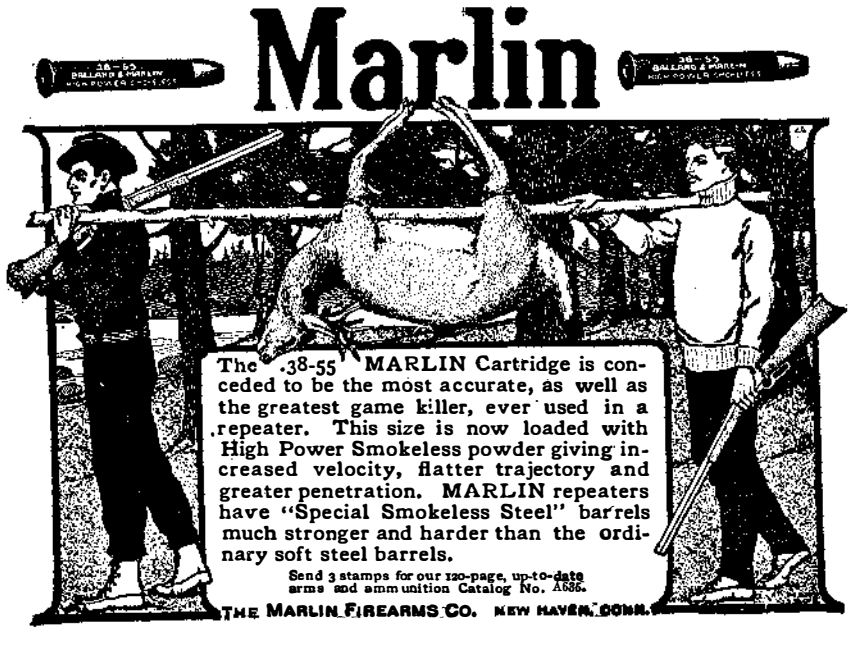

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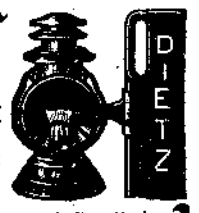

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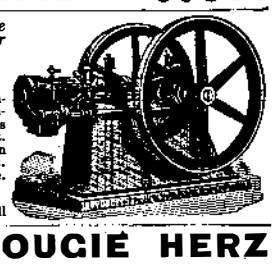

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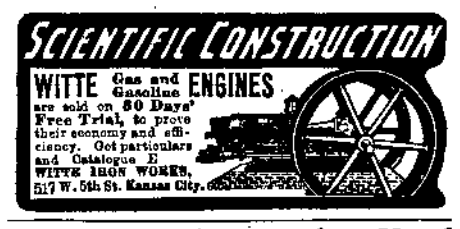

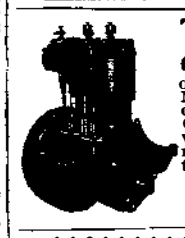

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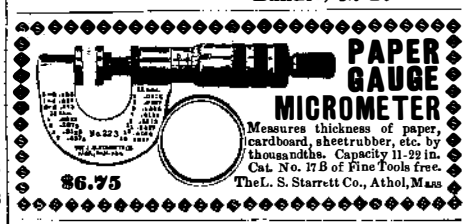

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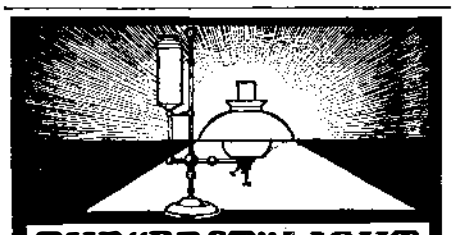
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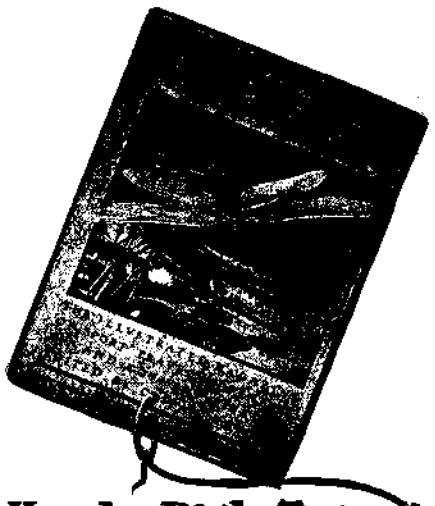
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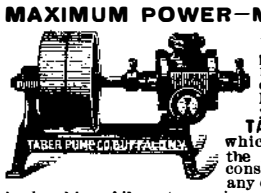
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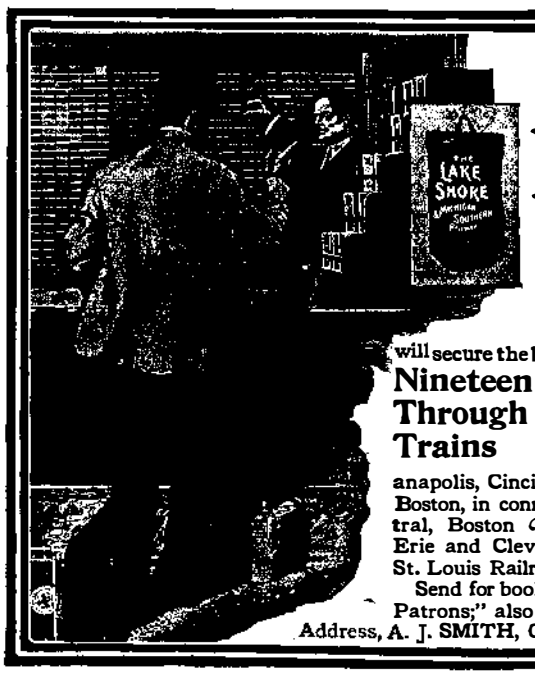

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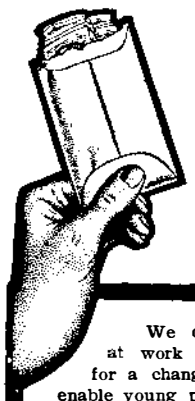

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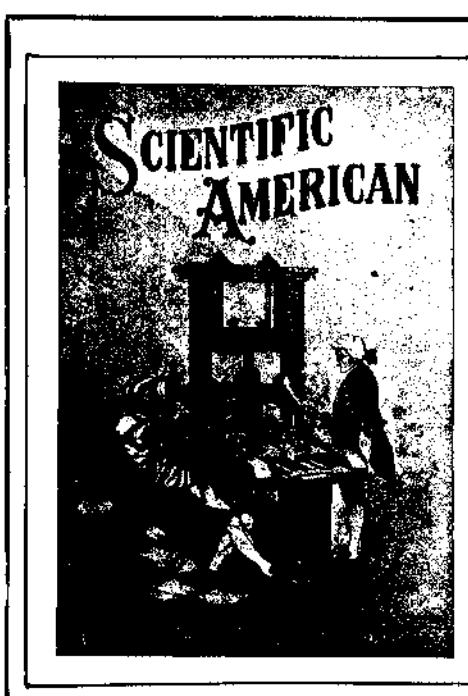

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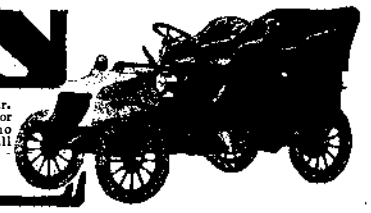

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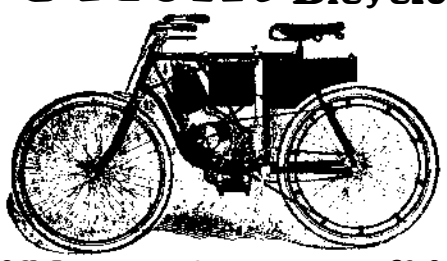

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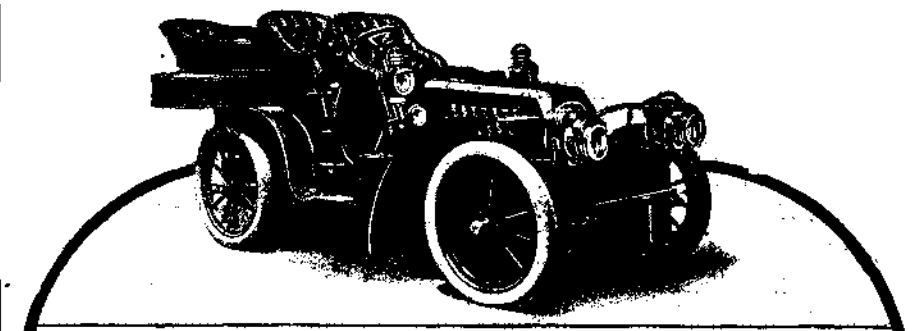

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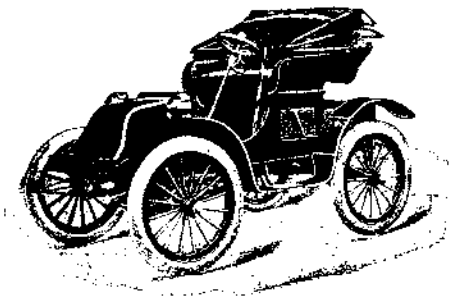

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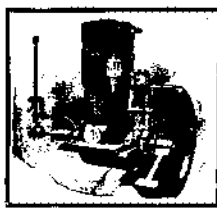

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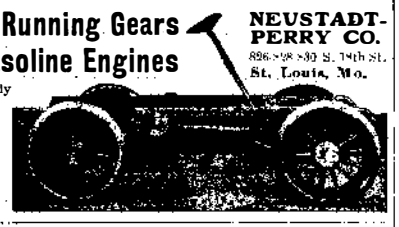

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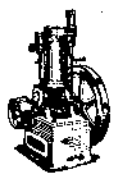

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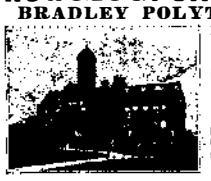

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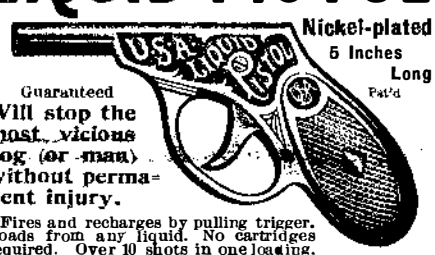

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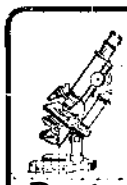

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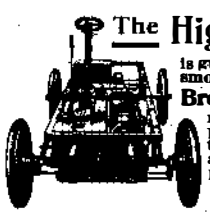

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